SAINT JOHN RIVER BASIN
Fort Fairfield, Maine

LAKE CHRISTINA DAM
ME 00226

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
Waltham, Mass. 02154

SEPTEMBER 1981

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

SEP 30 1981

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Lake Christina Dam (ME-00226) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Agriculture and to the owner, McCain Foods Corporation, Easton, ME. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Agriculture for your cooperation in in this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting, Division Engineer

Incl
As stated

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Saint John River Basin
Fort Fairfield, Maine
Prestile River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earthfill structure that is about 5800 ft. long and thirty ft. high. It is intermediate in size with a hazard potential of high. In event of failure of the dam there is the potential for loss of more than a few lives. No urgent or emergency actions are required for the dam based on this inspection Remedial measures include repairing the damaged intake structure concrete and thestoplogs, removing the trash from the reservoir along the dam and cutting the overgrown vegetation from the embankments.

LAKE CHRISTINA DAM, Fort...

ME 00226

ST. JOHN RIVER BASIN
FORT FAIRFIELD, MAINE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.	:	ME 00226
Name of Dam	:	Lake Christina Dam
Town	:	Easton
County & State	:	Aroostook, Maine
Stream	:	Prestile River
Date of Inspection	:	November 7, 1979

BRIEF ASSESSMENT

In 1967, Lake Christina Dam was constructed to augment downstream flow for industrial use. The dam is an earthfill structure that is approximately 5,800 feet long and thirty feet high with a twelve foot wide crest. At the top of the dam (elev. 662.5') the reservoir capacity is approximately 13,900 acre-feet. The project has two principal features; the earthfill embankment and the outlet works.

The drop inlet spillway made up of a 5' x 12.5' x 25' high (inside dimensions) vertical concrete structure that discharges at the downstream toe of the dam through a 60" diameter concrete conduit. The inlet is designed for free flow over the five-foot wide sill at Elev. 626.5'. This sill can be raised by approximately 5' using stoplogs. Flow can also be augumented by opening the 24" low level inlet that discharges into the base of the shaft. Both upstream and downstream embankments along the length of the dam are over-grown with vegetation. The upstream slope is 2:1 and the downstream slope is 3:1 from visual approximation. The general condition of the dam and the spillway is fair. After the original construction in 1967 the dam was raised approximately five feet to its present height at approximate Elev. 662.5'. This increase in volume allowed elimination of the emergency spillway which was filled to 662.5. When the crest was raised the emergency spillway was filled in to the same level (elev. 662.5'). The visible section of the drop inlet spillway was cracked and spalled, the stoplogs were badly rotted, and the reservoir shoreline had large deposits of floating trash.

Based on a maximum storage of approximately 13900 acre-feet Lake Christina Dam is classified as an intermediate size structure. The dam's hazard classification has been established as high based on the potential for loss of more than a few lives in the event of a dam failure. The test flood (equivalent to the PMF) was estimated for the 5.06 square mile drainage area of rolling terrain using the "Preliminary Guidance for Estimating Maximum Probable Discharge in Phase I

Safety Investigations", New England Division Corps of Engineers, March 1978. This yielded a peak inflow of 5,900 cfs and a routed peak outflow which is negligible. The computed maximum reservoir level was approximately 4.9' below the embankment crest and overtopping of the embankment would not occur.

No urgent or emergency actions are required for Lake Christina Dam based on this inspection. Remedial measures include repairing the damaged intake structure concrete and the stoplogs, removing the trash from the reservoir along the dam, and cutting the overgrown vegetation from the embankments. These actions should be completed within one year.

J.E. Giles, Jr., P.E.
Project Manager
Massachusetts Registration No. 1643

This Phase I Inspection Report on Christina Reservoir Dam (ME-00226) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

J W Finegan

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservior was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project compliance with OSHA rules and regulations is also excluded.

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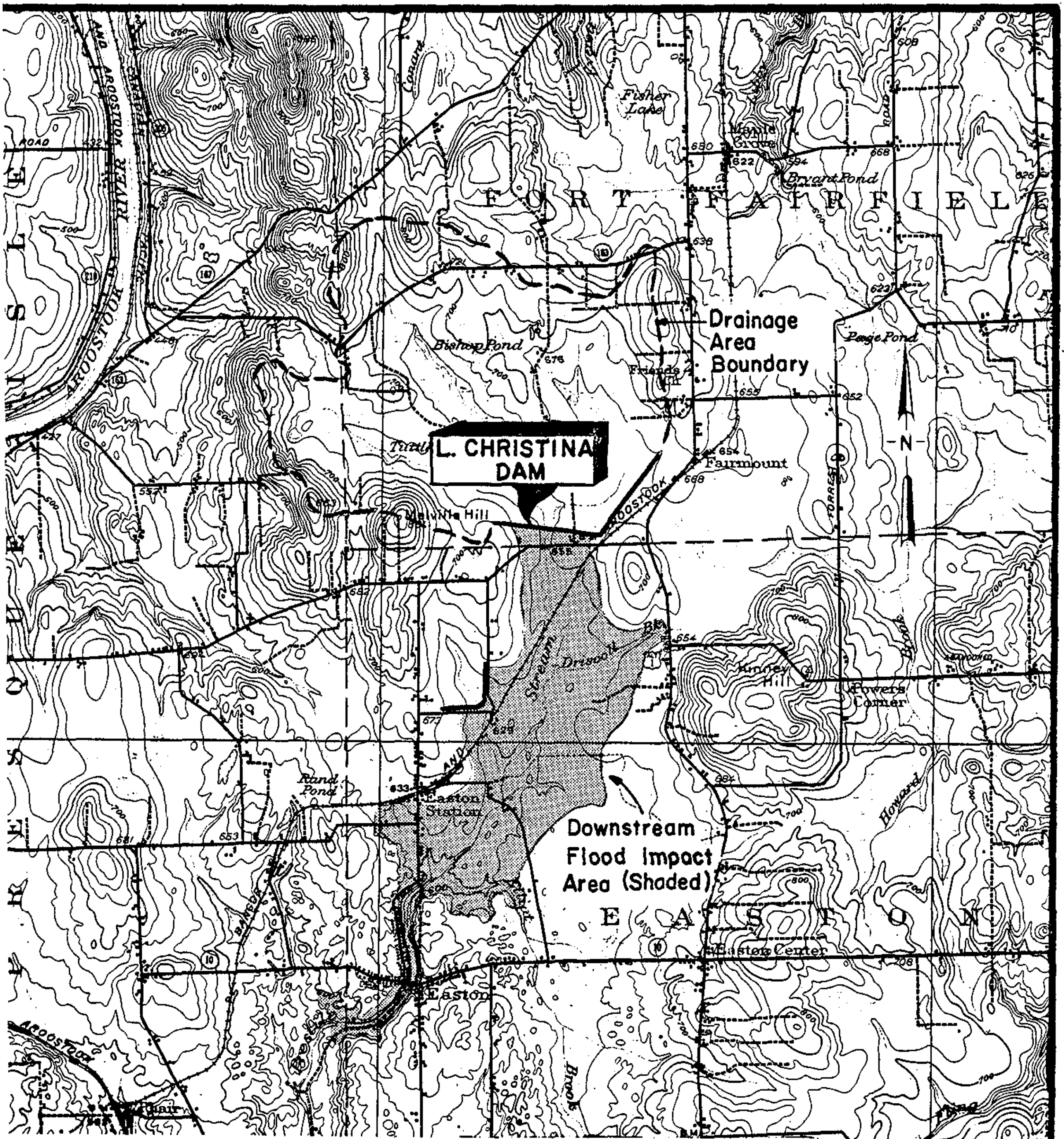
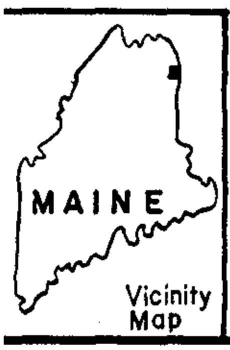
OVERVIEW PHOTOGRAPH



FROM: USGS MARS HILL, ME. QUADRANGLE MAP 15' MIN.



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SCALE: 1"=1 MILE

LAKE CHRISTINA DAM LOCATION MAP

U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM

MAIN

DATE	SEPT 1981	
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NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

LAKE CHRISTINA DAM, FORT FAIRFIELD, MAINE

SECTION I

PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Chas. T. Main, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Chas. T. Main, Inc. under a letter of November 6, 1979 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0011 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) The purposes of the inspection program are: To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

(1) Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

(2) A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

(3) Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

(4) An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 Description of Project

a. Location - The Lake Christina Dam is located on Prestile River three and one/half miles northeast of the town of Easton, Maine. The dam location is included on U.S.G.S. 15 minute series Quadrangle, Mars Hill, Maine with approximate coordinates of N46°41'24", W67°53'30".

b. Description of Dam and Appurtenances - The project consists of two main features, an earthfill dam and a drop inlet spillway. The dam embankment is approximately 5,800 feet long and 30 feet high with a 12 foot wide crest at Elevation 662.5. The fill materials are of glacial till origin with zoning limited to placing the more impervious material in the core and the more pervious material in the outside shells. The upstream embankment is sloped at about 2H:1V with some dumped rock cover observed at the shore line. The downstream embankment is sloped at about 3H:1V. The reservoir is normally kept between Elevations 652.5 and 657.5 with a maximum depth of about twenty feet. A trench drain runs along the downstream toe with a gravel blanket drain incorporated into the structure at the spillway outlet.

The drop inlet spillway consists of a reinforced concrete shaft (5' x 12.5' x 25' high inside dimensions) that opens into a 60" I.D. reinforced concrete pipe. The pipe is equipped with anti-seep collars and discharges at the downstream toe directly into a rip-rapped spilling basin. A 24" drain which discharges into the base of the spillway shaft has a sluice gate control which is operated from the top of the shaft. The drop inlet shaft is open on the upstream side only; a five foot wide opening that has a fixed bottom sill at Elevation 652.5 but can be raised by using stoplogs. The top of the opening is at the top of the shaft (Elevation 660') and the top of the shaft is covered with wooden planks.

The original construction drawings for the dam are included in Appendix B. Since the original construction in 1967 the structure underwent a major revision. This revision raised the height of the dam by five feet, filling in the emergency spillway at the same time. The drop inlet structure was changed by raising it five feet and enclosing three side of the original inlet. There were no as-built drawings available which show these revisions. Photographs taken during the field investigation are shown in Appendix C.

c. Size Classification - The maximum embankment height is approximately 30 feet above the downstream toe and the maximum storage is 13,900 acre feet at the crest. With this storage capacity the dam falls into the intermediate size classification (greater than 1,000 and less than 50,000 acre-feet) in accordance with Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - This facility is classified as a high hazard potential dam based on the potential for loss of more than a few lives in the event of a dam failure in 5-7 occupied dwellings downstream of the dam.

e. Ownership - The dam and associated works are owned by the McCain Foods Corporation Easton, Maine, 04740, (207-488-2561).

f. Operators - The project is designed for unsupervised operation. The only manual operations required involve operation of the sluice gate and the installation of the stoplogs. The project is operated and maintained by the McCain Foods Corporation plant engineering personnel. This plant is approximately two miles downstream of the dam. The responsible person is Mr. Jack Downing, the plant engineer at the McCain Plant, Telephone (207) 488-2561.

g. Purpose of Dam - Originally, the dam was built to create a reservoir that would augment low water flow, supplying year-round water to a sugar beet mill. The project was undertaken under the direction of Mr. Fred Vahlsing who is now in Houston, Texas. The mill failed financially. Subsequently, the McCain Foods Corporation of Easton, Maine purchased the project and surrounding land where they located their existing food processing plant. The dam performs the same function for the McCain's Plant as it was originally intended. That is, it augments low flows in the downstream channel, the Prestile Stream, on which the plant depends for water. The downstream channel is also used by local farmers for irrigation.

h. Design and Construction History - The dam was designed by Mr. William Whited of Houlton, Maine and constructed by the Bridge Construction Company of Presque Isle, Maine, in 1967. Within three years of construction the dam and the intake structure were raised five feet to the existing level. At that time the emergency spillway was filled in to the same level as the dam, elev. 662.5'. No additional modifications were reported by Mr. Downing. Mr. Whited is presently residing in Portland, Maine and is an engineering consultant (phone 207-774-2135).

i. Normal Operating Procedures - The reservoir is normally maintained between Elevations 652.5 and 657.5. The level is controlled by stoplogs which have to be manually installed. All flood flows are passed through the outlet works designed for uncontrolled discharge. No other operating procedures are in evidence.

1.3 Pertinent Data

a. Drainage Area - Lake Christina Dam controls a drainage area of 5.06 square miles. The watershed ranges from Elevations 860 to 630 feet and is approximately 50 percent wooded and 50 percent agricultural.

b. Discharge at Damsite

(1) Outlet Works - The reservoir is controlled by a drop inlet that uses stoplogs to maintain the required level of the reservoir. The level can be varied approximately five feet from elevation 652.5 to 657.5 feet. A 24"Ø asphalt coated CMP provides the capability to drain the reservoir to Elev. 638.25'. This is controlled by a 24" sluice gate.

(2) Maximum known flood - Unknown.

(3) Spillway capacity at top of dam - N/A.

(4) Spillway capacity at test flood elev. - 380 cfs

(5) Spillway capacity at normal pool elevation - N/A.

(6) Total project discharge at top of dam - N/A.

(7) Total project discharge (assuming 24" drain is open) at test flood elevation - 460 cfs (without stop logs).

c. Elevations (feet above NGVD)

(1) Streambed at toe of dam	632.0
(2) Bottom of cutoff	N/A
(3) Maximum tailwater	Unknown
(4) Normal Pool	652.5
(5) Full flood control pool	Unknown
(6) Spillway crest	varies from 652.5 without stoplogs to 657.5 with stoplogs
(7) Design surcharge (Original Design)	Unknown
(8) Top of dam	662.5 ±

(9) Test flood surcharge | 657.6

d. Reservoir (Length in feet)

(1)	Normal pool	6000
(2)	Flood control pool	N/A
(3)	Spillway crest pool	6000
(4)	Top of dam	12,000
(5)	Test flood pool	10,000

e. Storage (acre-feet)

(1)	Reservoir at Elev. 652.5	3,800
(2)	Flood control pool	N/A
(3)	Spillway crest pool	3,800
(4)	Top of dam	13,900
(5)	Test flood pool	7,308

f. Reservoir Surface (acres)

(1)	Reservoir at Elev. 652.5	480
(2)	Flood-control pool	N/A
(3)	Spillway crest	480
(4)	Test flood pool	700
(5)	Top of dam	900

g. Dam

(1)	Type	Earthfill
(2)	Length	5,800 feet
(3)	Height	30 feet
(4)	Top Width	12 feet

(5) Side Slopes — Upstream 2 Hor. to 1 Vert. Downstream 3 Hor. to 1 Vert.

(6) Zoning — Unknown

(7) Impervious Core — Unknown

(8) Cutoff — None

(9) Grout curtain — None

(10) Other — None

h. Diversion and Regulating Tunnel - None

i. Spillway (There is no emergency spillway)

(1) Type - concrete drop inlet to 60" concrete conduit

(2) Length of sill - 5 feet

(3) Crest elevation - varies 652.5 to 657.5

(4) Gates - None

(5) U/S Channel - Natural bottom of Lake Christina

(6) D/S Channel - Natural Channel of Prestile River

(7) General - Opening without stoplogs is 5' wide x 10' high. Inside dimensions of drop inlet shaft are 5' x 12.5'.

j. Regulating Outlets

(1) Invert - 638.25

(2) Size - 24" Dia.

(3) Description - Reservoir drain

(4) Control Mechanism - 24" ϕ sluice valve w/screw operator

(5) Other - Grating provided on upstream face; drain discharges into base of drop inlet shaft.

SECTION 2

ENGINEERING DATA

2.1 Design

Original construction prints of the Lake Christina Dam were obtained from the engineering consultant who was responsible for its design, Mr. William E. Whited of Portland, Maine, phone (207) 774-2135. Subsurface information was submitted to Mr. Whited from a local geotechnical firm, William Gorrill Associates. Mr. Whited stated that the subsurface investigation revealed an underlying base of coarse gravel in some areas of the foundation. This feature was incorporated into his design as added drainage for the dam. The dam was also designed with a gravel blanket and trench drain at the downstream toe. Original design computations and subsurface data were unavailable. There are no operating records, instrumentation data or hydrological records available for the dam and surrounding environment.

2.2 Construction

The original dam construction was performed by the Bridge Construction Company of Presque Isle, Maine in 1967. According to Mr. Whited, the dam was constructed using controlled compaction methods with local glacial till for the earth fill.

Mr. Jack Downing, chief engineer for the McCain Foods Plant, stated that there is very little information available concerning the alteration to the dam which raised the crest by five feet. It is not known who did the design or construction. No construction records nor photos of the original installation and later alteration were available. The original construction drawings were reviewed and a set of these is included in Appendix B.

2.3 Operation

No formal operational procedures were available for review. The spillway is an uncontrolled structure requiring manual removal or replacement of the stop logs. Mr. Downing stated that the 24" drainage inlet has been opened on occasion during dry summer months to augment the downstream flow of the Prestile River. No problems were encountered.

2.4 Evaluation

a. Availability: The Owner made the project available for inspection.

b. Adequacy: The lack of design data did not allow for a definitive review. Evaluation must be based on visual inspection, past performance, and engineering judgment.

c. Validity: The limited data available restrict evaluation of the Lake Christina Dam and appurtenances to the visual inspection and engineering judgment. The field inspection indicated that the external features of the dam and appurtenances for the most part agree with those shown on the available plans with the exception of the later alteration that raised the crest and intake structure by five feet.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General - The field inspection was conducted by L. Seward and J. Jonas of Chas. T. Main, Inc. on 7 November 1979. The inspection included walking the entire length of the dam. On the date of inspection, the Lake Christina Dam and intake structures were in fair condition. No urgent or emergency actions are required at this time.

b. Dam

(1) Crest - The embankment crest was true to line with no apparent dips, sags, cracks or other evidence of distress (Photos 4, 5 & 6). The crest is grass covered with no pavement. There was some water retained in ruts on the crest. The general appearance of the crest was good.

(2) Upstream slopes - Rip-rap up to 12" in size was observed at the waterline but could not be seen consistently along the upstream face. The original as-built slope of 3:1 appears steeper on the upstream embankment; nearer 2:1. The entire upstream face above the water level (elev. 652.5') was overgrown with thick grass and some low shrubbery (photos 4, 7 & 8). In addition there are several partially buried tree trunks at scattered locations on the upstream slope. The general appearance of the upstream slope was fair.

(3) Downstream slope - The downstream slope also appeared overgrown with thick vegetation (photos 5 & 6). There was no observed erosion, sags, or slides. The general appearance of the downstream slope was fair.

(4) Downstream toe - No boils or seeps were observed. The general appearance of the downstream toe was fair.

(5) Underdrain system - The dam has a gravel blanket toe drain according to the original drawings. There is also a trench drain shown in the original drawings but this feature was not apparent during the visual inspection. If the trench drain is present the downstream toe is too heavily overgrown with vegetation for it to be very effective.

(6) Instrumentation - No instrumentation was observed.

c. Appurtenent Structures

Drop Inlet Spillway - The concrete in the intake structure is cracked and broken on two corners (photo 1). The wooden walkway used to access the intake structure was damaged and unsafe. At the downstream toe where the outlet works discharged (photo 2 & 3), the 60" concrete conduit appeared in good condition.

d. Reservoir Area

A large amount of trash and debris had accumulated along the shoreline adjacent to the dam covering the rip rap. (photos 1, 7 & 8). There was no observed damage along the shoreline due to wave action or other water movement.

e. Downstream Channel

From the reservoir outlet to the Conant Road Crossing (photo 9) located about 250' away, the downstream channel (known as the Prestile Stream) was clear and flowing freely through the swamp. Further downstream, approximately two miles, is located the McCain Foods Processing Plant (seen in the background of photo 3). This draws a constant water supply from the Prestile Stream.

3.2 Evaluation

a. In general, the dam, the spillway and the reservoir are in fair condition. The present condition reflects minimum maintenance by the project owner and operators.

b. The following items require attention:

1. Cracked concrete in intake structure.

2. Repair wooden walkway used to access the intake structure.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General: The spillway is an uncontrolled drop inlet. The only manual operations required include the handling of stoplogs at the spillway inlet and operating the low level inlet sluice gate.

b. Description of Downstream Warning System: No warning system or emergency evacuation plans are in effect for this project.

4.2 Maintenance Procedures

a. General: No regular maintenance procedures are in effect for this project.

b. Operating Facilities: No regular maintenance procedures for the project operating facilities are specified. The reservoir level is lowered as required to maintain a downstream flow.

4.3 Evaluation

Maintenance procedures should be established to remove the debris from the reservoir and downstream slope, remove the trees and brush from the embankments up to twenty feet beyond the downstream toe, and replace the deteriorating concrete of the intake structure.

The owner should establish a formal downstream warning system to follow in the event of emergency conditions.

SECTION 5

EVALUATION OF HYDROLOGIC AND HYDRAULIC FEATURES

5.1 General - The watershed is 5.06 square miles of rolling terrain. The dam is located on the Prestile River approximately 3-1/2 miles northeast of Easton, Maine. The earth embankment develops sufficient storage (20 inches) to entirely contain the Probable Maximum Flood (PMF) peak of 5,890 cfs. This was selected as the test flood.

5.2 Design Data - The dam was designed by William E. Whited of Portland, Maine, and constructed by the Bridge Construction Company, Inc. from Presque Isle, Maine. No hydraulic or hydrologic calculations are available. The dam embankment is approximately 5,800 feet long and 30 feet high with crest at Elev. 662.5'. The reservoir level is controlled by a free flowing outlet through a 60" Ø conduit with overflow sill at Elev. 652.5'. The embankment has an upstream slope of approximately 2:1 and downstream slope of 3:1.

5.3 Experience Data - There is no past hydrology data available for this project.

5.4 Test Flood Analysis - Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge", dated March 1978, the watershed classification (rolling), and hydraulic computations, the test flood for this high hazard, intermediate size dam is estimated to be equivalent to the PMF of 5,890 cfs, 1164 CSM. The flood routing starting elevation was the outlet works overflow sill at Elev. 652.5', no stoplogs were considered. The Maximum Probable Runoff is assumed to be 13 inches. Although about 460 cfs discharge can be provided through the outlets, for conservative reasons, no outflow was assumed during the test flood event. Without considering discharge from the outlet works, runoff into the reservoir yields a volume of 3,500 ac-ft. which brings the total volume in the reservoir to 7,308 ac-ft. This volume corresponds to a water surface elevation of 657.6 feet. The crest of the dam at elev. 662.5 feet will not be overtopped.

If we consider stoplogs in the spillway, the starting elevation becomes 657.5 ft. For 13 inches runoff and again without considering discharge from the outlet works, the total volume in the reservoir becomes 10808 ac-ft. and corresponding water surface elevation of 660.6 feet.

5.5 Dam Failure Analysis - The initial surface elevation 657.6 feet and 7,308 ac-ft. capacity is considered in dam breach analysis. The impact of failure of the dam was assessed using the "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs" prepared by the Corps of Engineers. The breach discharge was estimated with the maximum water surface elevation during the test flood. The shape of the dam requires special treatment in the breach analysis. The structure is made up of two long straight embankments joining at a wide angle. Discharge from a breach in one side will flow into a different catchment than a discharge from the opposite side. For this reason the calculations were performed by considering a breach in the embankment which poses a greater threat to a populated area; the right embankment. The breach width (924 ft) was selected to be 35 percent of the length of the dam at mid-height.

The maximum discharge that would result from a failure of the west embankment is about 200,000 cfs. This results in at least five residences that are located about two miles downstream (at Reach 8) being impacted by a flood wave of approximately 20 feet. Prior to failure these same residences would not be damaged; the downstream channel height would be three feet in this area. Conant Road immediately downstream would also be inundated and probably washed away from the flood wave. Therefore, this dam is classified as a high hazard dam since in the event of a dam failure more than a few lives would be lost.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observation

The visual inspection of the Lake Christina Dam on November 7, 1979 and August 13, 1981 revealed a sound structure with no evidence of instability. There were no dips, sags, or depressions observed in the embankment.

6.2 Design and Construction Data

There were no design or construction records available for review in preparing this report. The original construction drawings were reviewed in accessing the structural stability.

6.3 Post Construction Changes

After original construction of the project was completed the crest was raised an additional five feet. The emergency spillway was filled into the same level as the crest (Elev. 662.5'). Visual observation showed that the upstream slope appeared steeper than the original 3:1 design, possible due to post construction changes. The inlet structure was also raised approximately five feet.

6.4 Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - This inspection indicates that Lake Christina Dam is in fair condition. The following points should be noted:

(1) The inlet structure has cracked and broken concrete and shows signs of continuous deterioration unless repaired.

(2) The stoplogs are badly damaged and need replacing.

(3) The wooden walkway to access the inlet structure is damaged and unsafe. It should be repaired, replaced, or removed.

(4) The dam embankments are heavily overgrown with shrubs and thick weeds.

(5) An excessive amount of floating debris is in the reservoir. During a high runoff this could interfere with the inlet structure.

b. Adequacy of Information- The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could no be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection and engineering judgment.

c. Urgency - The remedial measures presented below should be implemented by the owner within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

a. The owner should have a registered engineer investigate the underdrain system.

7.3 Remedial Measures The owner should:

a. Repair the damaged concrete of the spillway inlet structure at the next drawdown of the reservoir.

b. Inspect condition of rip-rap at next drawdown of reservoir.

c. Replace damaged stoplogs at the inlet opening.

d. Repair or replace the walkway used to access the spillway inlet structure.

e. Trim the vegetation on the dam embankments and remove shrubs, logs and debris. The downstream area should be clear to at least twenty feet from the toe.

f. Remove the floating debris from the reservoir.

g. Establish a system to monitor the project during periods of intense rainfall.

h. Develop a formal downstream warning system to be used in the case of an emergency at the dam.

i. Implement a monthly visual inspection program of the dam and its appurtenances. Observations should be recorded in a maintenance log.

j. Conduct a technical inspection of the dam every year.

k. Obtain and maintain a set of as-built drawings and inspection reports.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

FIELD INSPECTION CHECK LIST

INSPECTION CHECKLIST
PARTY ORGANIZATION

ROJECT Lake Christina Dam

DATE Nov. 7, 1979

TIME 11:00 A.M.

WEATHER Fair - Sunny 40°F

U.S. ELEV. ______ U.S. ____ DN.S.

ARTY:

. Lewis B. Seward	Hydrologist	6.	
. Jan N. Jonas	Civil Engineer	7.	
. J. E. Giles, Jr.	Project Manager*	8.	
.		9.	
.		10.	

PROJECT FEATURE INSPECTED BY REMARKS

. All of the project features were inspected by each party member.

* At Site August 13, 1981

INSPECTION CHECKLIST

PROJECT Lake Christina Dam

DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam

NAME Lewis B. Seward

DISCIPLINE Hydro

NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
M EMBANKMENT	
est Elevation	Not known
rrent Pool Elevation	Not known
ximum Impoundment to Date	Not known
rface Cracks	None visible
vement Condition	Grassed fare with riprap
vement or Settlement of Crest	None apparent
teral Movement	None apparent
rtical Alignment	Good
rizontal Alignment	Good
ndition at Abutment and at Concrete ructures	No visible failures
dications of Movement of Structural ems on Slopes	None visible
espassing on Slopes	Some buried tree trunks in u/s slope
gitation on Slopes	Heavy grass with low schrubs
oughing or Erosion of Slopes or utments	None
ck Slope Protection - Riprap ilures	Riprap at waterline & outlet structure - not consistent
usual Movement or Cracking at or ar Toes	None visible
usual Embankment or Downstream epage	Downstream toe wet - stagnant water
ping or Boils	None visible
undation Drainage Features	None visible
e Drains	None visible
strumentation System	None visible

INSPECTION CHECKLIST

PROJECT Lake Christina

DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam

NAME Lewis B. Seward

DISCIPLINE Hydro

NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
UTLET WORKS - INTAKE CHANNEL AND NTAKE STRUCTURE	
. Approach Channel	None
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
). Intake Structure	
Condition of Concrete	Cracked and broken concrete, steel reinforcement exposed, new concrete stained; sluice gate reach ro d bent.
Stop Logs and Slots	
Stop logs were broken	Stop logs were broken and rotten, propped from behind with timbers

INSPECTION CHECKLIST

PROJECT Lake Christina Dam — DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam — NAME Lewis B. Seward

DISCIPLINE Hydro — NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
TLET WORKS - CONTROL TOWER	
Concrete and Structural	
General Condition	Poor
Condition of Joints	Old concrete -open joints; new concrete joints stained
Spalling	Some
Visible Reinforcing	At corners
Rusting or Staining of Concrete	Old concrete at joints
Any Seepage or Efflorescene	None observed
Joint Alignment	Not applicable
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	At corners of intake
Rusting or Corrosion of Steel	Some staining
Mechanical and Electrical	
Air Vents	Not applicable
Float Wells	Not applicable
Crane Hoist	Not applicable
Elevator	Not applicable
Hydraulic System	Not applicable
Service Gates	Gate valve stem was bent
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

INSPECTION CHECKLIST

PROJECT Lake Christina
DATE Nov. 7, 1979
PROJECT FEATURE Earthfill Dam
NAME Lewis B. Seward
DISCIPLINE Hydro
NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Not accessible for inspection
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECKLIST

PROJECT Lake Christina

DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam

NAME Lewis B. Seward

DISCIPLINE Hydro

NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
UTLET WORKS - OUTLET STRUCTURE ND OUTLET CHANNEL	
eneral Condition of Concrete	Concrete pipe seated on cast in place saddles - good condition
ust or Staining	None
palling	None
rosion or Cavitation	None
isible Reinforcing	None
ny Seepage or Efflorescence	None
ondition at Joints	Good - tight joints
rain Holes	None
hannel	Natural stream channel - grassed banks with small shrubs
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Good - grassed shallow banks

INSPECTION CHECKLIST

PROJECT Lake Christina Dam DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam NAME Lewis B. Seward

DISCIPLINE Hydro NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	None
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	None
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c. Discharge Channel	Natural stream bed
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	

INSPECTION CHECKLIST

PROJECT Lake Christina Dam — DATE Nov. 7, 1979

PROJECT FEATURE Earthfill Dam — NAME Lewis B. Seward

DISCIPLINE Hydro — NAME Jan N. Jonas

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	Wood walkway with steel rod ties - at dam approach girders broken; poor condition
Bearings	
Anchor Bolts	None
Bridge Seat	Bridge Seat*
Longitudinal Members	Wood girders
Under Side of Deck	
Secondary Bracing	
Deck	Wood planks
Drainage System	None
Railings	2 by 4 - wood
Expansion Joints	None
Paint	Peeling
b. Abutment & Piers	Not applicable
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

*Concrete beam at dam, steel angle at the structure

APPENDIX B

ENGINEERING DATA

1. Original construction drawings are on file with

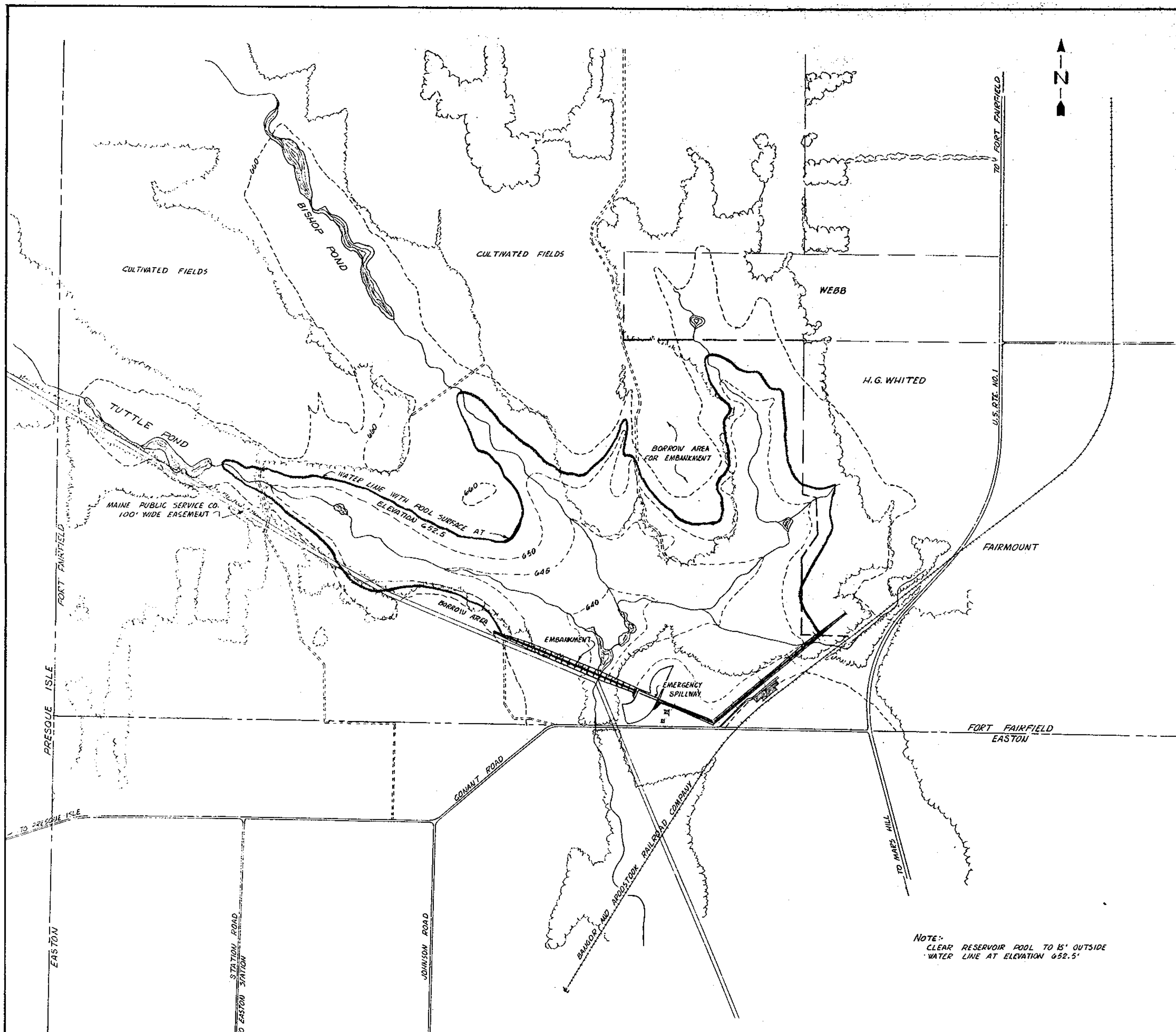
   Mr. William E. Whited from the Dearbon/Whited A-E Firm, P.O. Box 127, Portland, Maine, 04112

2. No past inspection reports were available for review or are known to exist.

LIST OF ENCLOSED DRAWINGS

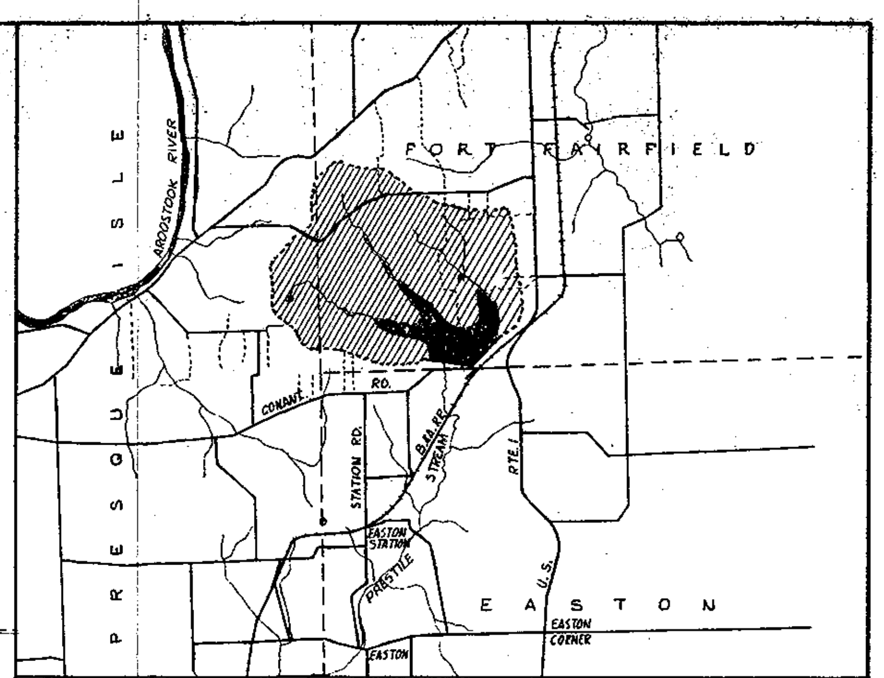
	Title	Drawing Number
1.	Location and Storage Area Plan	1 of 6
2.	Plan of Damsite	2 of 6
3.	Seepage Drain Details	3 of 6
4.	Plan Profile of Principal Spillway	5 of 6
5.	Details of Principal Spillway	6 of 6

NOTE: All of these drawings pertain to the original construction. They do not show the revisions performed which raised the dam five feet.



STORAGE AREAS PLAN

0 500 1000 2000 3000
FEET



LOCATION PLAN

1 ½ 0 1 2 3 4
MILES

MAINE SUGAR INDUSTRIES, INC.

UPPER PRESTILE STREAM RESERVOIR

DRAINAGE AREA	3,280	ACRES
FLOOD STORAGE AT EMERGENCY SPILLWAY CREST	644	ACRE FT.
RESERVOIR STORAGE AT PRINCIPAL SPILLWAY CREST	700,000,000	GALLONS
WATER SURFACE AREA AT PRINCIPAL SPILLWAY CREST	397	ACRES
HEIGHT OF DAM	19	FEET
VOLUME OF FILL		CU.YDS.

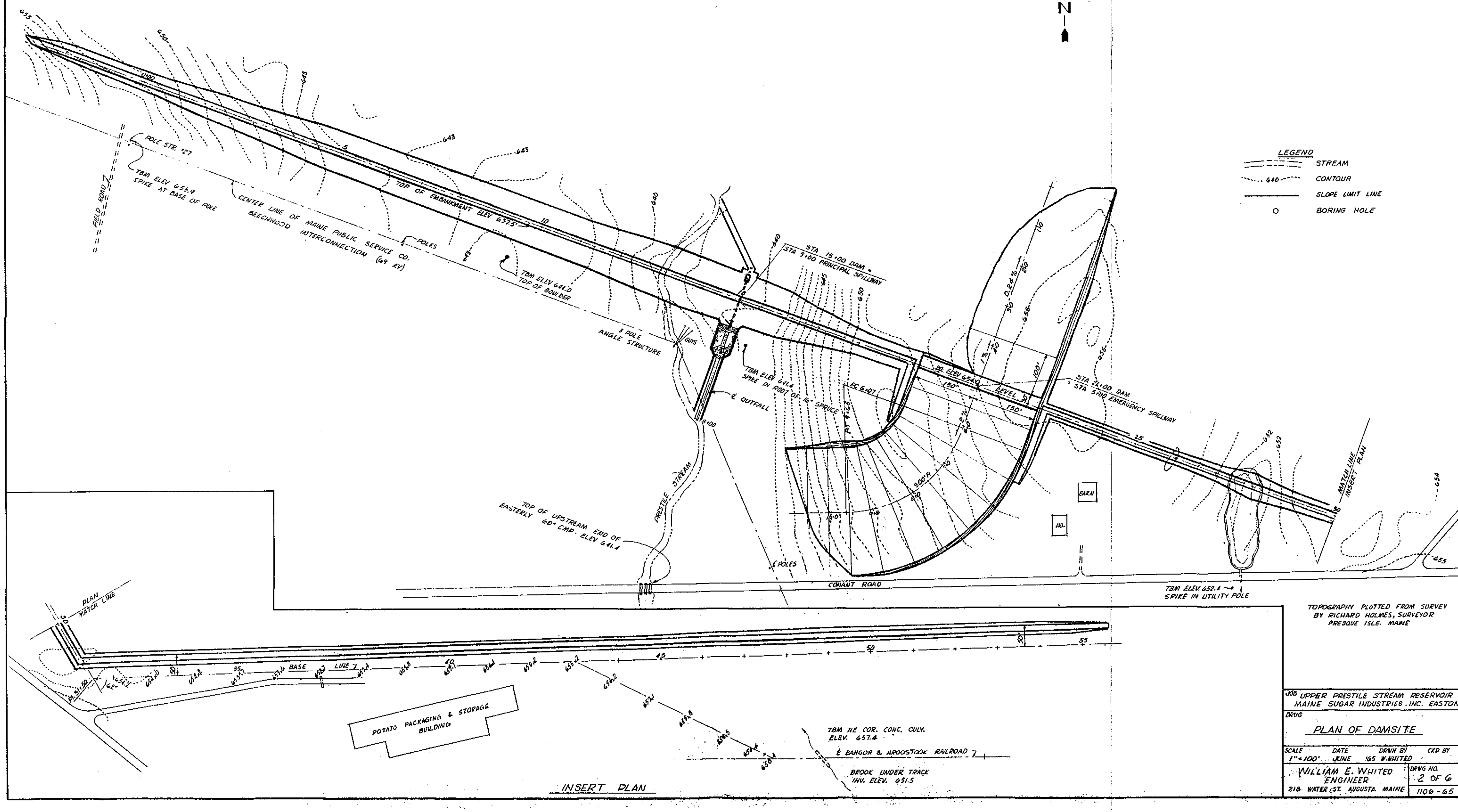
INDEX TO DRAWINGS

JOB UPPER PRESTILE STREAM RESERVOIR MAINE SUGAR INDUSTRIES, INC. EASTON			
DRWG LOCATION & STORAGE AREA PLAN			
SCALE SHOWN	DATE JUNE '65	DRWN BY W.WHITED	CKD BY
WILLIAM E. WHITED ENGINEER 218 WATER ST. AUGUSTA, MAINE			DRWG NO 1 OF 6 1106-65

GENERAL NOTES:

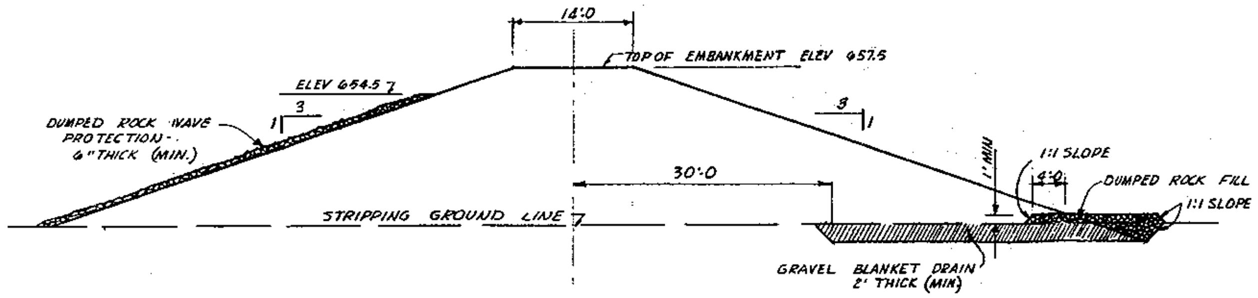
1. TOPSOIL IS TO BE REMOVED, STOCKPILED AND USED AS DIRECTED BY THE ENGINEER IN THE FIELD.
2. THE FOLLOWING AREAS ARE TO BE TOPSOILED AS DIRECTED BY THE ENGINEER IN THE FIELD.
   a. EMBANKMENT
      1. DOWNSTREAM FACE
      2. UPSTREAM FACE ABOVE PERMANENT POOL ELEVATION.
   b. EMERGENCY SPILLWAY
      1. SIDE SLOPES
      2. BOTTOM
3. GRUB UNDER EMBANKMENT TO 5:0 OUTSIDE SLOPE LIMIT LINES. GRUBBING DEPTH TO REMOVE ALL TOPSOIL AND VEGETATION ROOTS IN FIELDS AND CLEARED AREAS.

NOTE:
CENTER LINE OF EMBANKMENT 7:0 RIGHT OF SURVEY BASE LINE 1+00

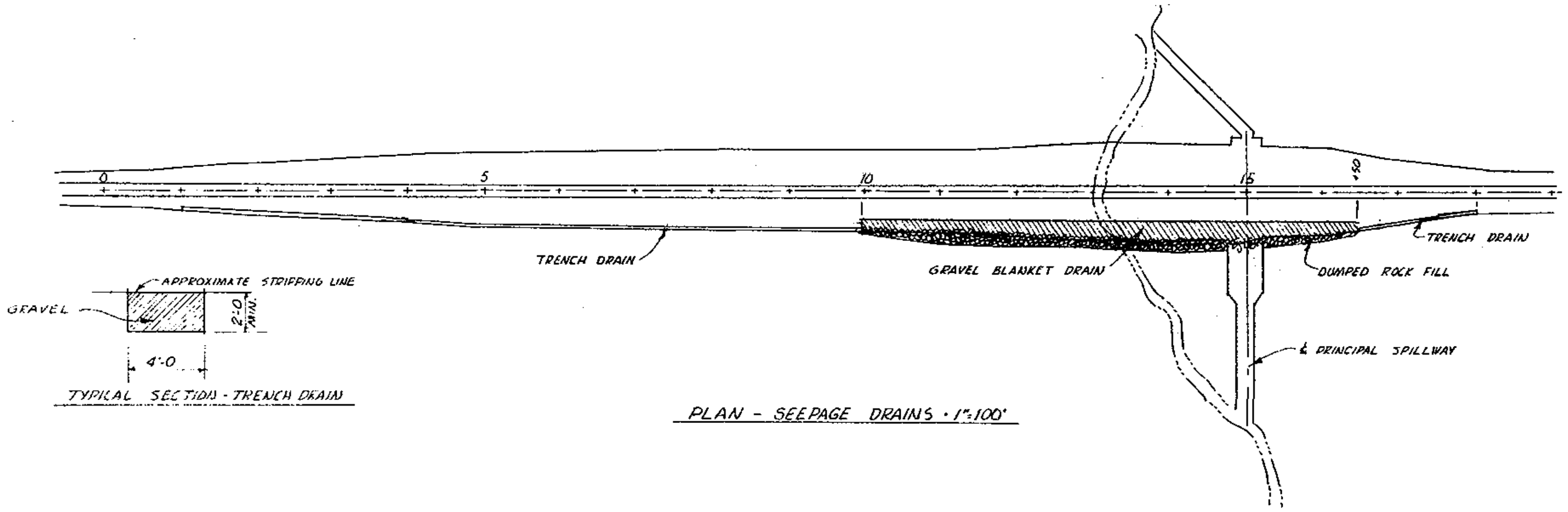


TOPOGRAPHY PLOTTED FROM SURVEY BY RICHARD HOLMES, SURVEYOR PRESQUE ISLE, MAINE

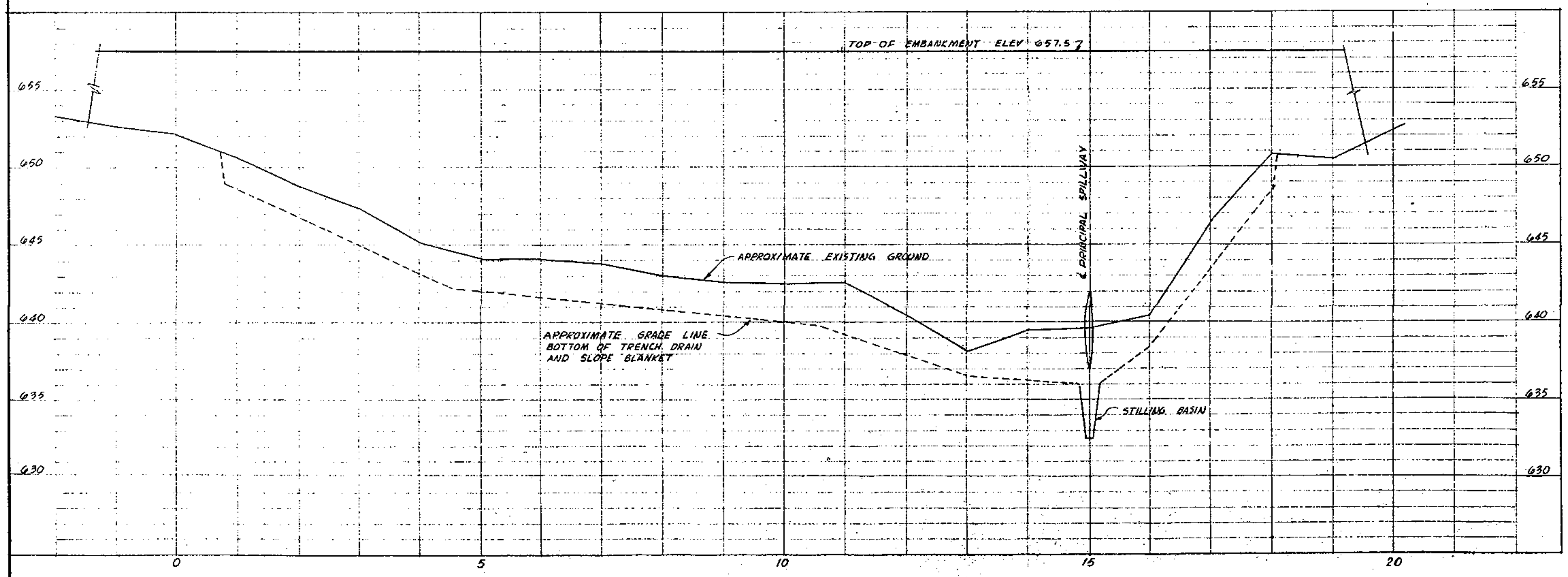
JOB	UPPER PRESTILE STREAM RESERVOIR MAINE SUGAR INDUSTRIES, INC. EASTON
DRWG	PLAN OF DAMSITE
SCALE 1" = 100'	DATE JUNE '65 · DRWN BY W. WHITED · CKD BY
WILLIAM E. WHITED ENGINEER 218 WATER ST. AUGUSTA, MAINE	DRWG NO. 2 OF 6 · 1106-65



TYPICAL SECTION THRU DAM · 1"=10'

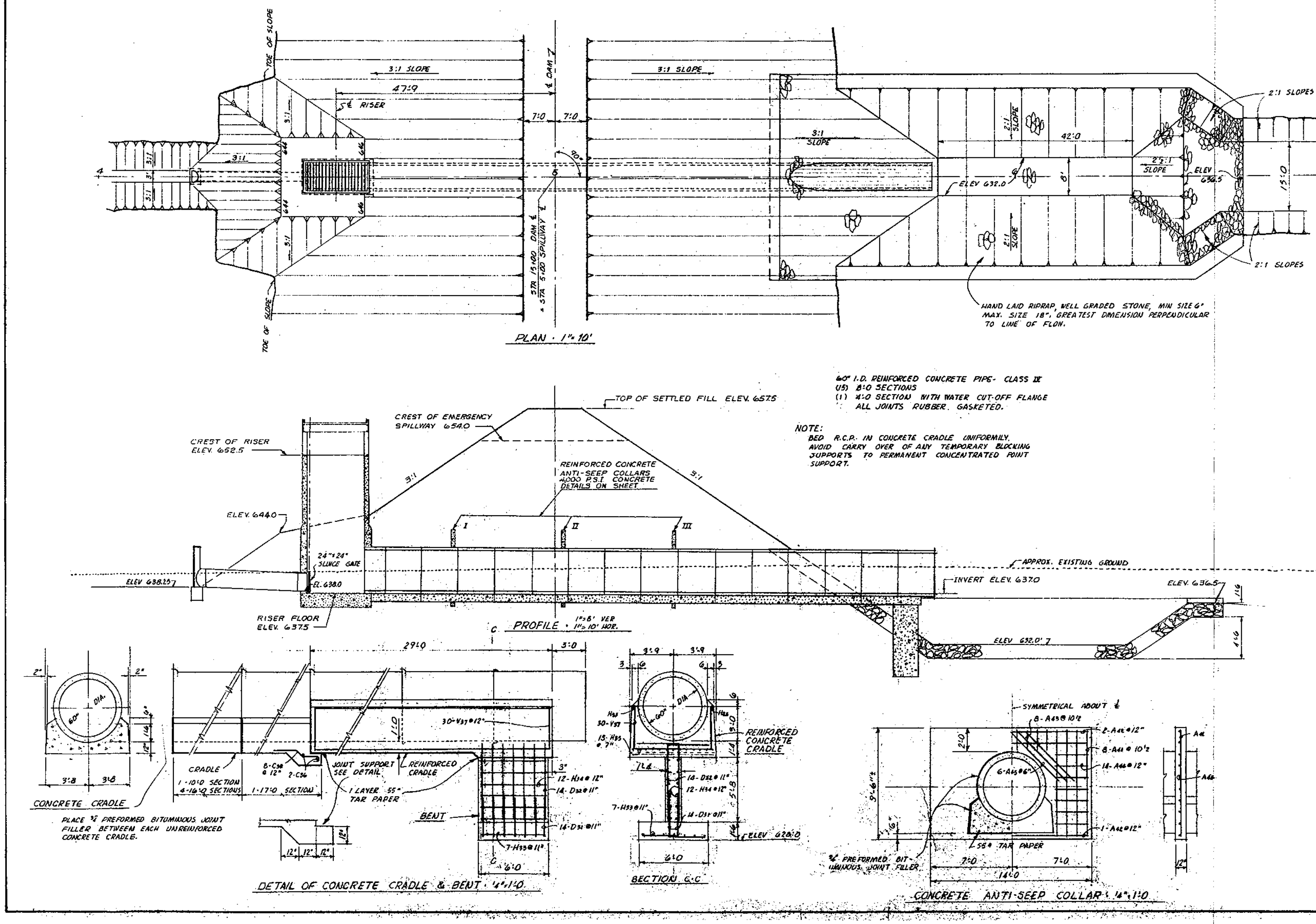


PLAN - SEEPAGE DRAINS · 1"=100'



PROFILE - SEEPAGE DRAINS · 1"=4' VER. 1"=100' HOR

JOB RESERVOIR ON PRESTILE STREAM MAINE SUGAR INDUSTRIES, INC. EASTON			
DRWG SEEPAGE DRAIN DETAILS			
SCALE SHOWN	DATE JUNE 65	DRWN BY W.W.	CKD BY
WILLIAM E. WHITED ENGINEER 218 WATER ST. AUGUSTA, MAINE		DRWG NO. 3 OF 6 1106-65	



REINFORCING SCHEDULE							
MARK	QUAN	SIZE	SKETCH	A	B	C	D
D31	14	#6		3'-3	3'-3		
D32	16	#6		6'-10	4'-0		
H33	7	#4	STRAIGHT	5'-6			
H34	12	#4		5'-6			
H35	15	#6		28'-8			
C36	2	#5		7'-0			
V37	30	#6		3'-10	7'-0	6'-6	
C38	8	#5		2'-0	9	1'-6	7
A41	8	#4		9'-0			
A42	3	#4		13'-8			
A43	8	#4		1'-8			
A44	14	#4		3'-0			
A45	6	#4		6'-0			

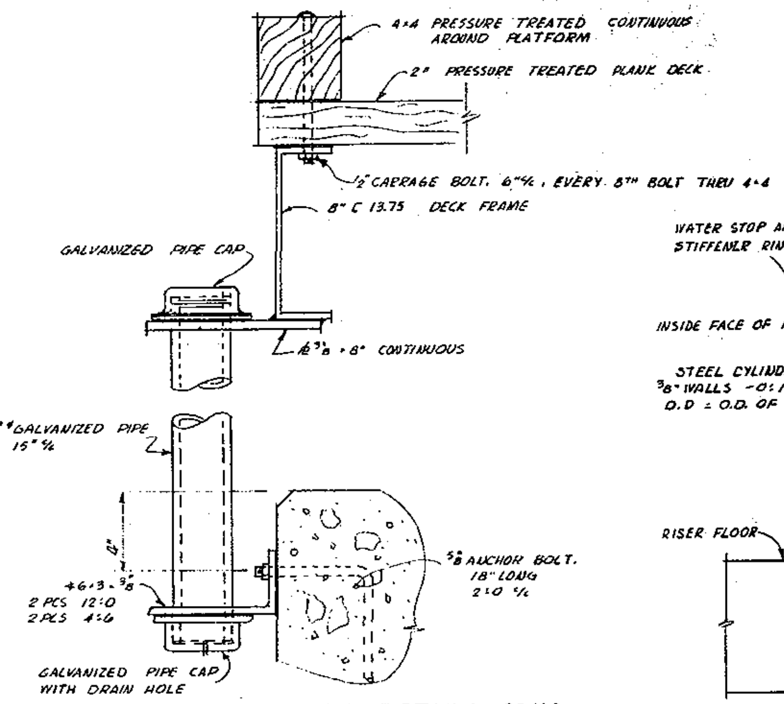
JOB RESERVOIR ON PRESTILE STREAM
MAINE SUGAR INDUSTRIES, INC. EASTON

DRWG **PLAN PROFILE OF PRINCIPAL SPILLWAY**

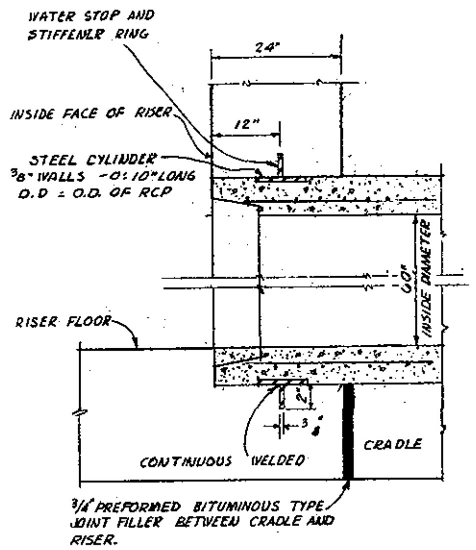
SCALE	DATE	DRWN BY	CKD BY
VERT. 1"= 5' HOR. 1"= 10	JUNE 65	D.G.	

WILLIAM E. WHITED
ENGINEER
21½ WATER ST. AUGUSTA, MAINE

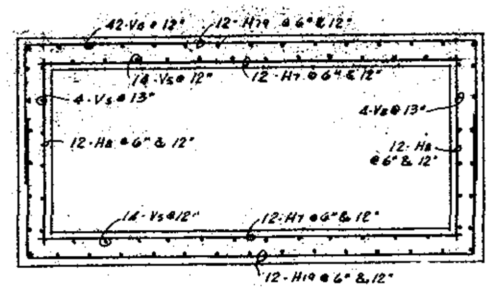
DRWG NO. 5 OF 6
1106-65



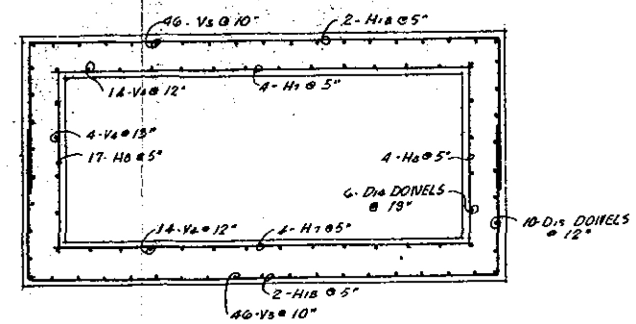
TRASH RACK DETAILS · 3"=1'-0



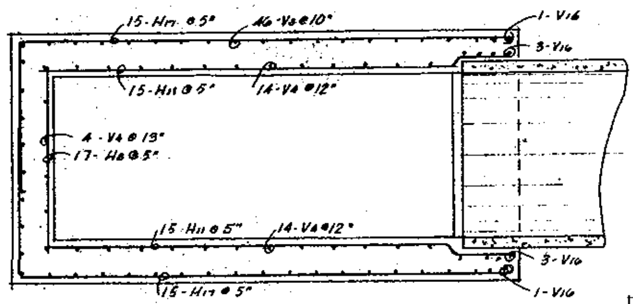
SPIGOT RING WALL FITTING
NO SCALE



SECTION "AA" · ⅜"=1'-0



SECTION - "BB" - ⅜"=1'-0

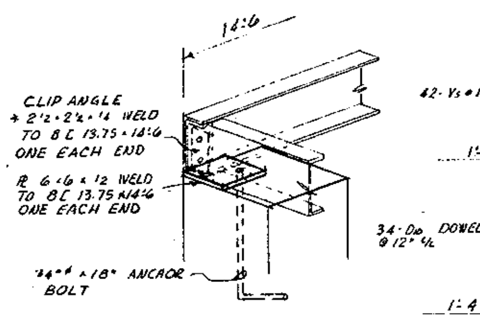


SECTION - "CC" · ⅜"=1'-0

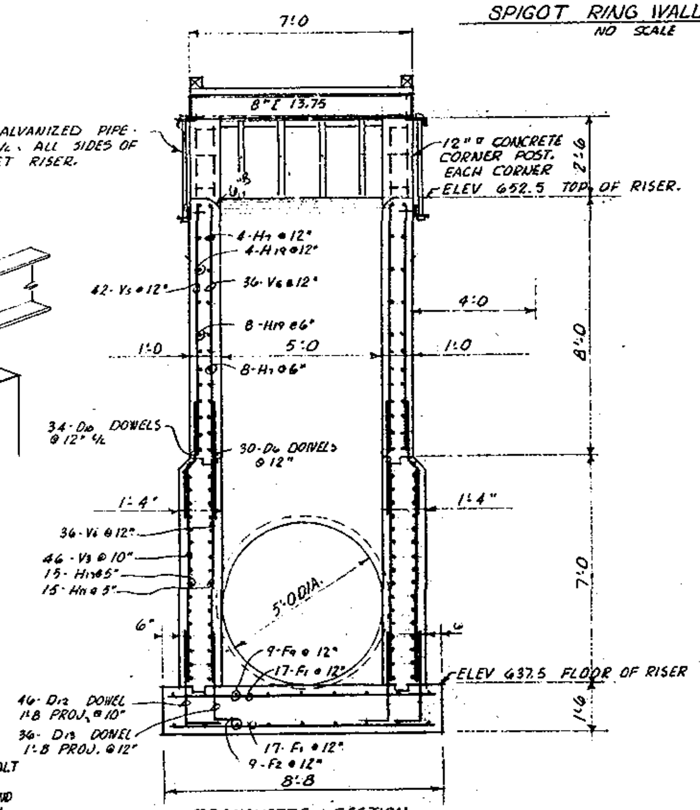
CONCRETE VOLUME	
POND DRAIN FTG.	0.44 C.Y.
INLET RISER FTG.	7.86 C.Y.
INLET RISER	
ELEV. 637.5 TO 644.5	12.98 C.Y.
ELEV. 644.5 TO TOP	11.93 C.Y.
TOTAL	33.21 C.Y.

REINFORCING SCHEDULE

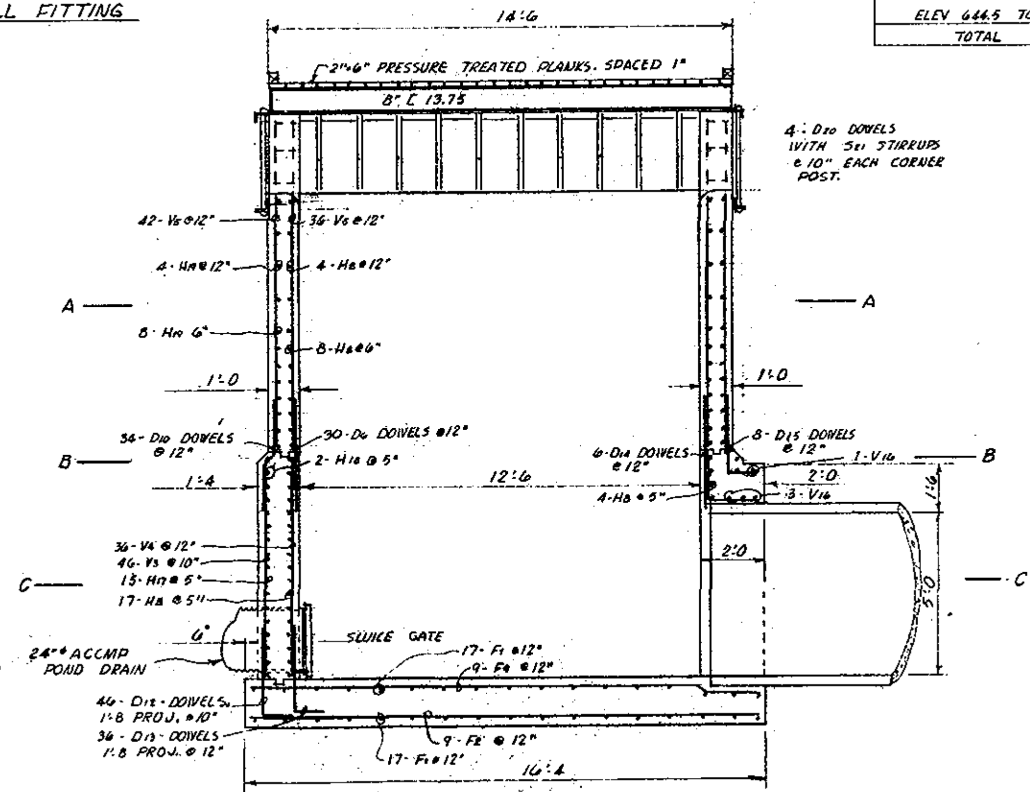
MARK	QUAN	SIZE	SKETCH	A	B	C	D
F1	34	#6	STRAIGHT	8'-2			
F2	9	#4		15'-10			
V3	46	#6		6'-8			
V4	32	#4		6'-8			
V5	78	#4		7'-9			
D6	30	#4		3'-0			
H7	32	#5		13'-0			
H8	45	#5		5'-6			
D20	16	#6		4'-4			
F9	9	#4		13'-10	1'-6	10	6
D10	34	#4		1'-8	10	6	4
H11	30	#5		12'-6	1'-6	10	6
D12	46	#6		2'-8	1'-4		
D13	36	#4		2'-8	1'-4		
D14	6	#4		3'-0	1'-8		
D15	10	#4		2'-4	1'-0		
V16	8	#6		5'-4	4'-8		
H17	30	#6	STD HOOK	4'-8	14'-6		
H18	4	#6		14'-10	4'-8		
H19	24	#6		14'-2	4'-4		
S21	12	#3		8			



CONNECTION DETAIL AT CORNER POSTS · NO SCALE

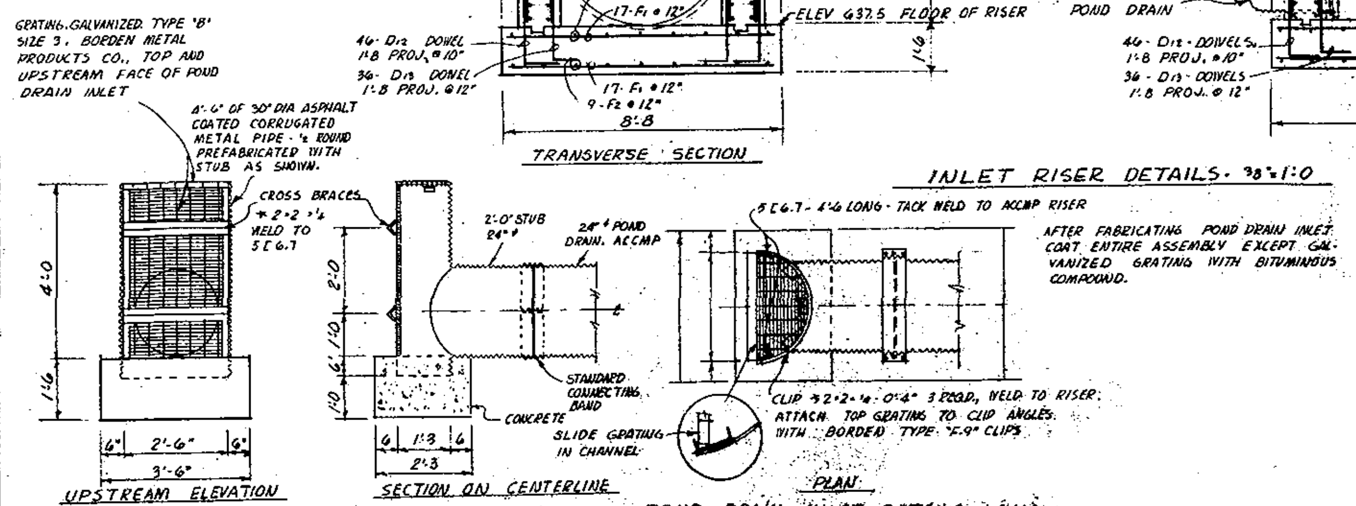


TRANSVERSE SECTION



LONGITUDINAL SECTION

INLET RISER DETAILS · ⅜"=1'-0



POND DRAIN INLET DETAILS · ½"=1'-0

GENERAL NOTES

1. BATCH & PLACE ALL CONCRETE PER LATEST AMERICAN CONCRETE INSTITUTE REQUIREMENTS.
2. CONCRETE :- 4,000 PSI COMPRESSIVE STRENGTH IN 28 DAYS.
   CEMENT CONTENT OF 664 LBS PER CU.YD.
   6% ENTRAINED AIR WITH AN AIR ENTRAING AGENT.
   AGGREGATES TO CONFORM TO ALL REQUIREMENTS OF THE STATE OF MAINE HIGHWAY COMMISSION STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES.
3. CURE CONCRETE BY KEEPING CONTINUALLY MOIST FOR FIRST SEVEN DAYS AFTER PLACING
4. CHAMFER EXPOSED EDGES OF CONCRETE ¾" UNLESS NOTED OTHERWISE.
5. REINFORCING STEEL SPLICES SHALL BE LAPPED 30 DIA.
6. REINFORCING STEEL IN CONCRETE PLACED AGAINST THE GROUND SHALL HAVE A MIN. OF 3" CLEAR COVER. WHERE FORMS ARE USED COVER SHALL BE 2" CLEAR.

JOB RESERVOIR ON PRESTILE STREAM MAINE SUGAR INDUSTRIES, INC. EASTON	
DRWG DETAILS OF PRINCIPAL SPILLWAY	
SCALE ⅜"=1'-0 · DATE JUNE - '65 · DRWN BY W.W. · CKD BY	
WILLIAM E. WHITED ENGINEER 218½ WATER ST. AUGUSTA, MAINE	DRWG NO. 6 OF 6
	1106 - 65

APPENDIX C

PHOTOGRAPHS

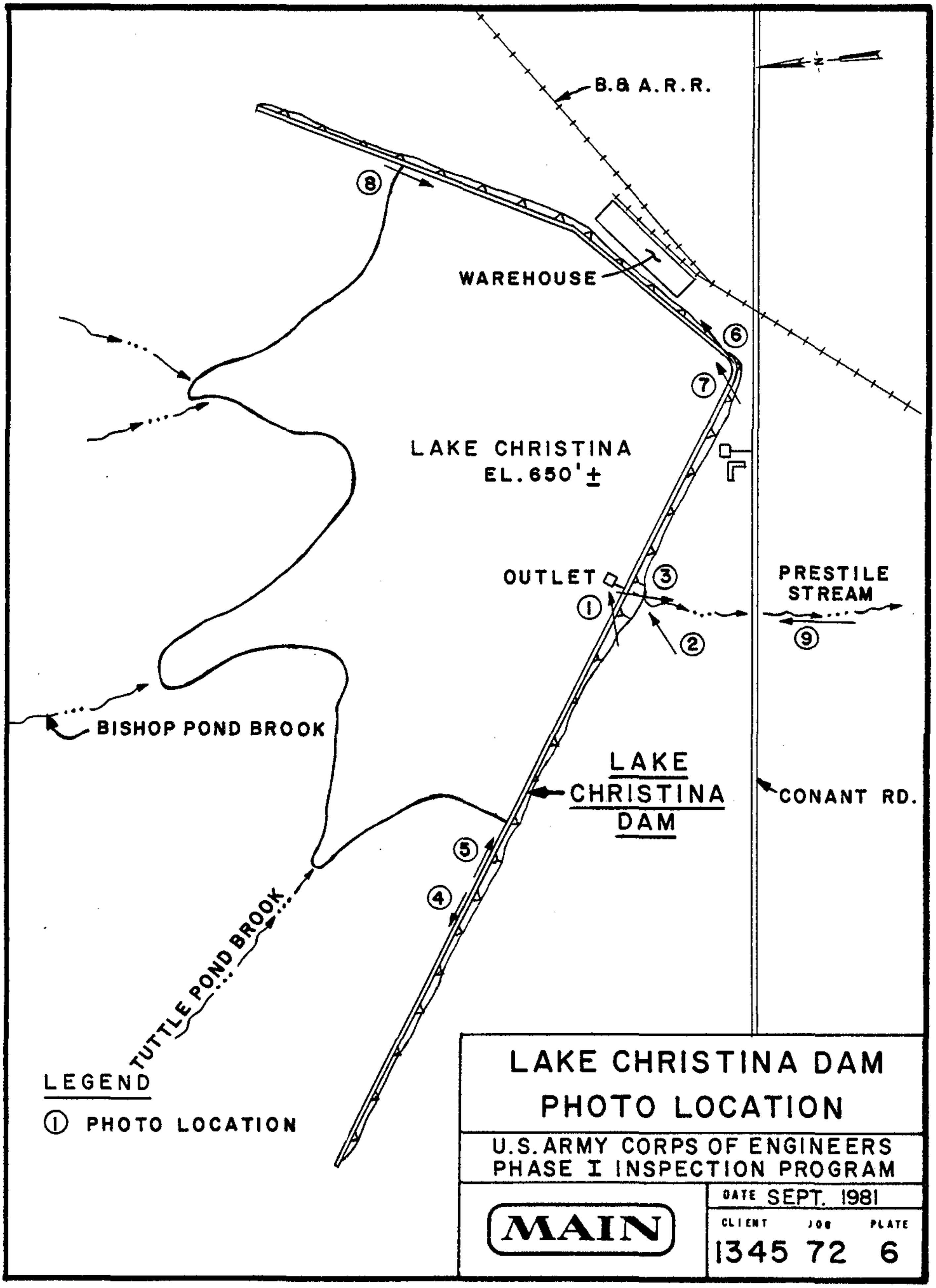

B.& A.R.R.
WAREHOUSE
LAKE CHRISTINA
EL. 650' ±
OUTLET
PRESTILE
STREAM
BISHOP POND BROOK
LAKE
CHRISTINA
DAM
CONANT RD.
TUTTLE POND BROOK
LEGEND
① PHOTO LOCATION
LAKE CHRISTINA DAM
PHOTO LOCATION
U.S. ARMY CORPS OF ENGINEERS
PHASE I INSPECTION PROGRAM
DATE SEPT. 1981
MAIN
CLIENT 1345
JOB 72
PLATE 6

Photo 1

Principal Spillway
Intake Structure

Photo 2

60" ø Principal
Spillway Outlet

Photo 3

Principal Spillway
Downstream Channel

Photo 4

Upstream Slope
& Crest

Photo 5

Right Abutment
Crest & Downstream
Slope

Photo 6

Left Embankment
Downstream
Slope

Photo 7

Trash Buildup at Junction Left Reach and Main Reach of Dam

Photo 8

Trash Buildup at Left Abutment

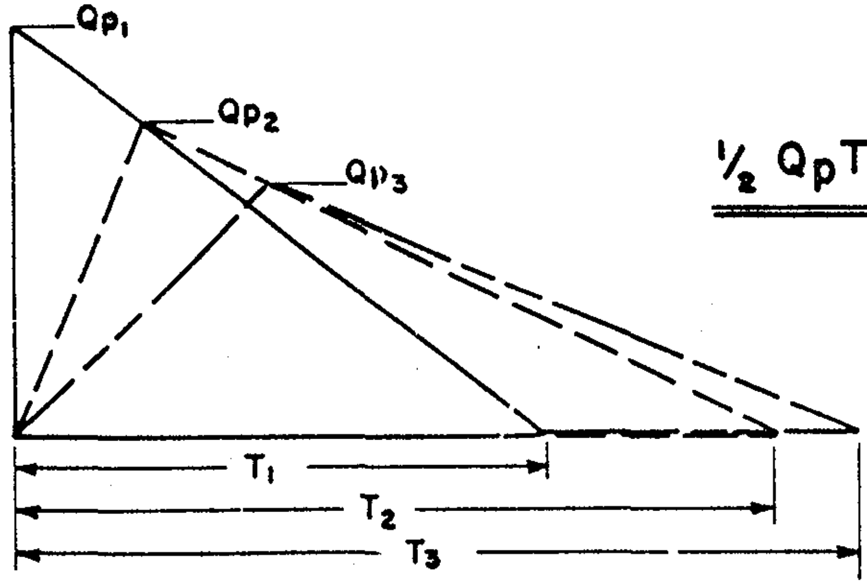
Photo 9

72"ø Culverts at Conant Road (Note Dam in Background)

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12\, S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27}\, W_b \sqrt{g}\; Y_o^{3/2}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(\text{TRIAL}) = Qp_1 \left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 \left(1 - \frac{V_{ave}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

MAIN

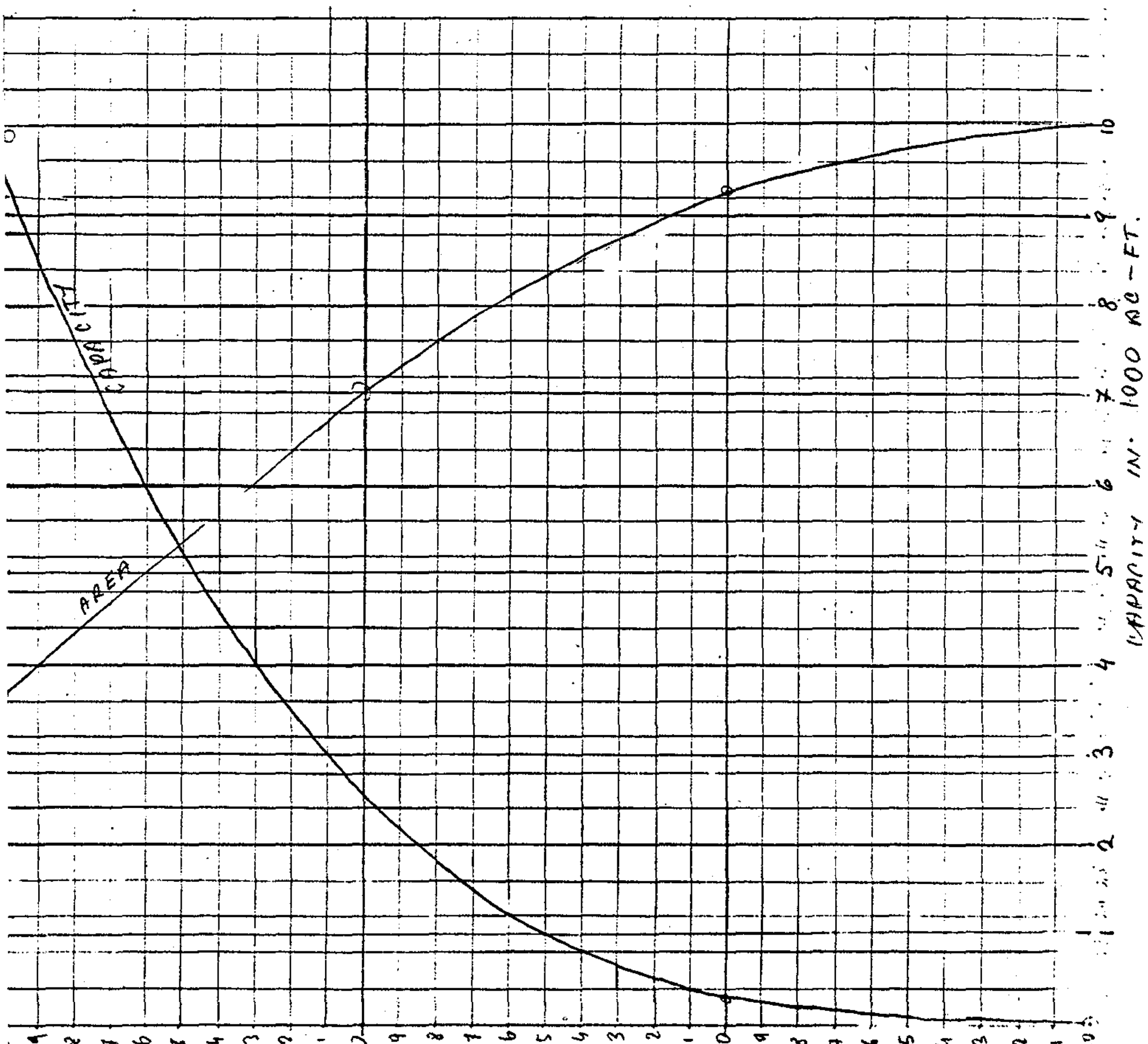
Client CORPS OF ENGINEERS Job No. 1245-072-018 Sheet 1 of 25

Subject FLOOD ROUTING THROUGH RESERVOIR By T. OTOJA Date 4-15-80

CHRISTINA RESERVOIR Ckd. Rev.

DETERMINATION OF AREA – CAPACITY CURVE

ELEV. (FT).	AREA (mi²)	AREA (AC.)	INCR. VOL. (AC-FT)	TOTAL VOL (AC-
630	0	0	0	0
640	0.146	93.2	311.0	311.
660	1.233	789.0	8 822.0	9133.



MAIN

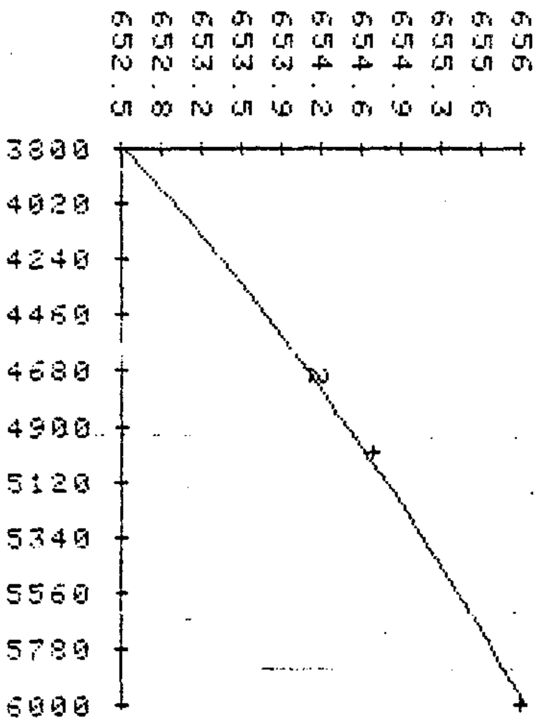
Client *CORPS OF ENGINEERS* Job No. *1345-072 -018* Sheet *2* of *25*

Subject *FLOOD ROUTING THROUGH CHRISTINA RESERVOIR* By *T. OTOVA* Date *3-4-81*

Ckd. ______ Rev. ______

```
   I          X(I)          Y(I)
   1       3800.0000      652.5000
   2       5000.0000      654.7000
   3       6000.0000      656.0000
   AOV: LOG REG:CODE 2
SOURCE/DF      SS       MS       F
TOTAL  2       6.3
REG    1       6.3      6.3  999.9
RESID  1       0.0      0.0
R SQUARE =          0.999

YHAT=    589.131+     7.691LOG X
```




```
   I          X(I           Y(I)
   1       3800.0000      652.5000
   2       5000.0000      654.7000
   3       6000.0000      656.0000
   AOV: LOG REG:CODE 2
SOURCE/DF      SS       MS       F
TOTAL  2       6.3
REG    1       6.3      6.3  999.9
RESID  1       0.0      0.0
R SQUARE =          0.999

YHAT=    589.131+     7.691LOG X
```

X(I)	Y(I)	YHAT	RESIDUALS
3800.00	652.50	652.53	-0.03
5000.00	654.70	654.64	0.06
6000.00	656.00	656.04	-0.04

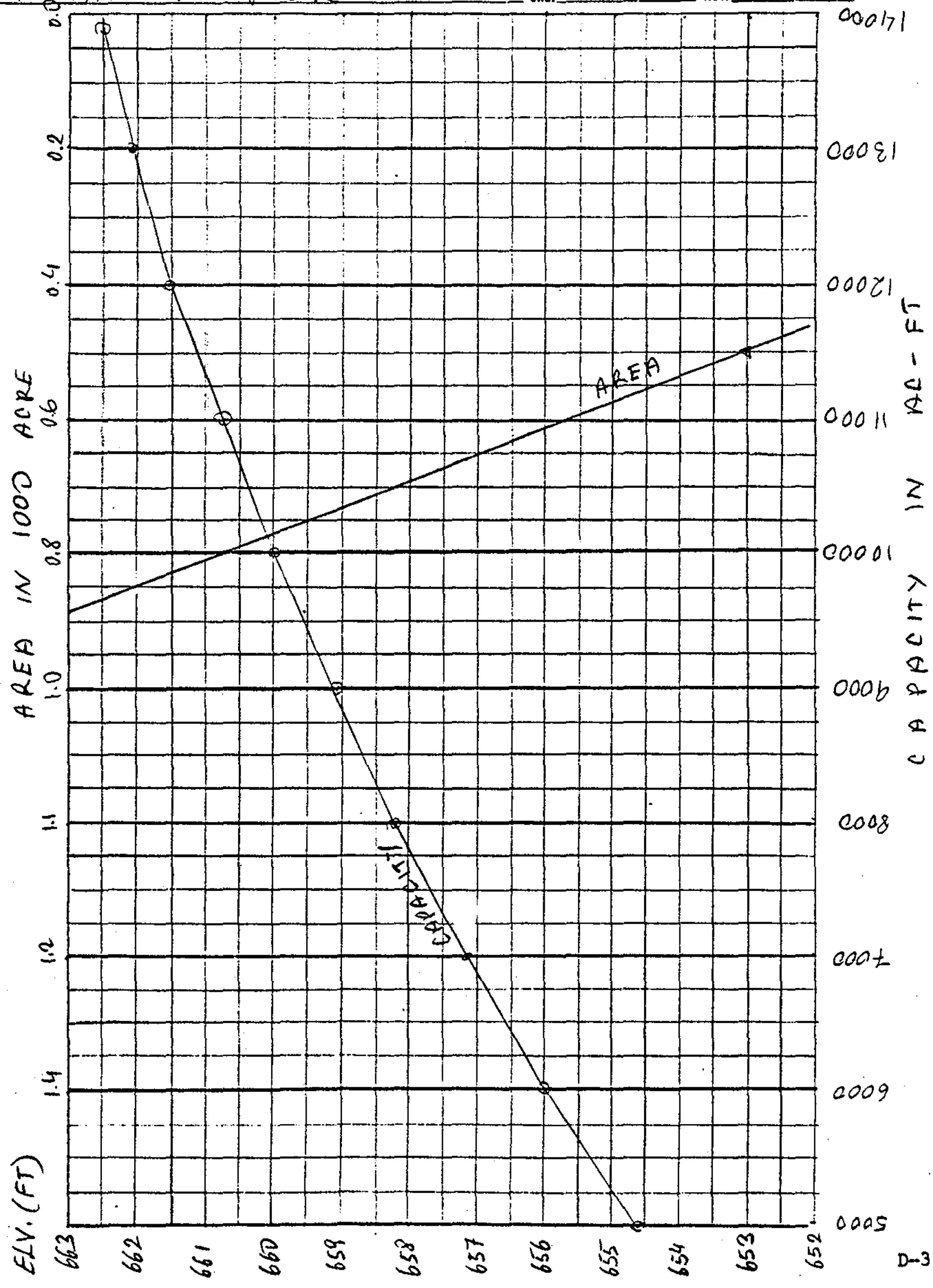
X(I)	YHAT
10000.00	659.97
11000.00	660.70
12000.00	661.37
9000.00	659.16
8000.00	658.25
7000.00	657.22
6000.00	656.04
5000.00	654.64
4000.00	652.92

MAIN

Client CORPS OF ENGINEERS — Job No. 1345-072-018 — Sheet 3 of 25

Subject FLOOD ROUTING THROUGH CHRISTINA RESERVOIR — By T. OTOVA — Date 5-5-81

Ckd. — Rev.



Client CORPS OF ENGINEERS Job No. 1345-072 -018 Sheet 4 of 25

Subject FLOOD ROUTING By T. OTOVA Date 5-4-81

CHRISTINA RESERVOIR Ckd. Rev.

PIPE SPILLWAYS

LOW LEVEL INLET

The formula used in these calcul ations is presented in the Burea u of reclamation's DESIGN OF SMALL DAMS (1977) Page 567, Figure B-10.

Ht = [2.5204*(1+Ke)/D^4 + 466.18*n2*L/D^(16/3)]*(Q/10)^2

Where,

Ht = Head in feet
Ke = Entrance loss coefficient
D = Diameter of pipe in feet
n = Mannings roughness coeffici ent
L = Lenght of culvert in feet
Q = Design discharge rate in cf s

Ke = .2

D = 2 (ft)

n = .01

L = 180 (ft)

ENTRANCE ELV = 635 (ft)

OUTLET ELV = 632 (ft)

ELEVATION (ft)	DISCHARGE (cfs)
646.29	60
648.77	65
651.46	70
[illegible]4.34	[illegible]
[illegible]7.41	[illegible]
660.69	[illegible]
661 37	[illegible]
662.06	[illegible]
662.4	87.5

PIPE SPILLWAYS

PRINCIPAL SPILLWAY

The formula used in these calcul ations is presented in the Burea u of reclamation's DESIGN OF SMALL DAMS (1977) Page 567, Figure B-10.

Ht = [2.5204*(1+Ke)/D^4 + 466.18*n2*L/D^(16/3)]*(Q/1[illegible] 2

Where,

Ht = Head in feet
Ke = Entrance loss coefficient
D = Diameter of pipe in feet
n = Mannings roughness coeffici ent
L = Lenght of culvert in feet
Q = Design discharge rate in cf s

Ke = .2

D = 5.33 (ft)

n = .01

L = 180 (ft)

ENTRANCE ELV = 635 (ft)

OUTLET ELV = 632 (ft)

ELEVATION (ft)	DISCHARGE (cfs)
636.37	300
637.95	350
639.78	400
641.85	450
644 16	500
646.71	550
649.51	600
652 5[illegible]	650
655.8[illegible]	700
[illegible] 76	750
[illegible]	760
660 [illegible]	770
662 [illegible]	790
663 51	792

MAIN

Client CORPS OF ENGINEERS	Job No. 1345-072 Sheet 5 of 25
Subject FLOOD ROUTING	By T. OTOVA Date 5-5-81
CHRISTINA RESERVOIR	Ckd. Rev.

SPILLWAY RATING TABLE

PRINC.SPWY INLET

The formula used in these calculations is weir discharge relationship :

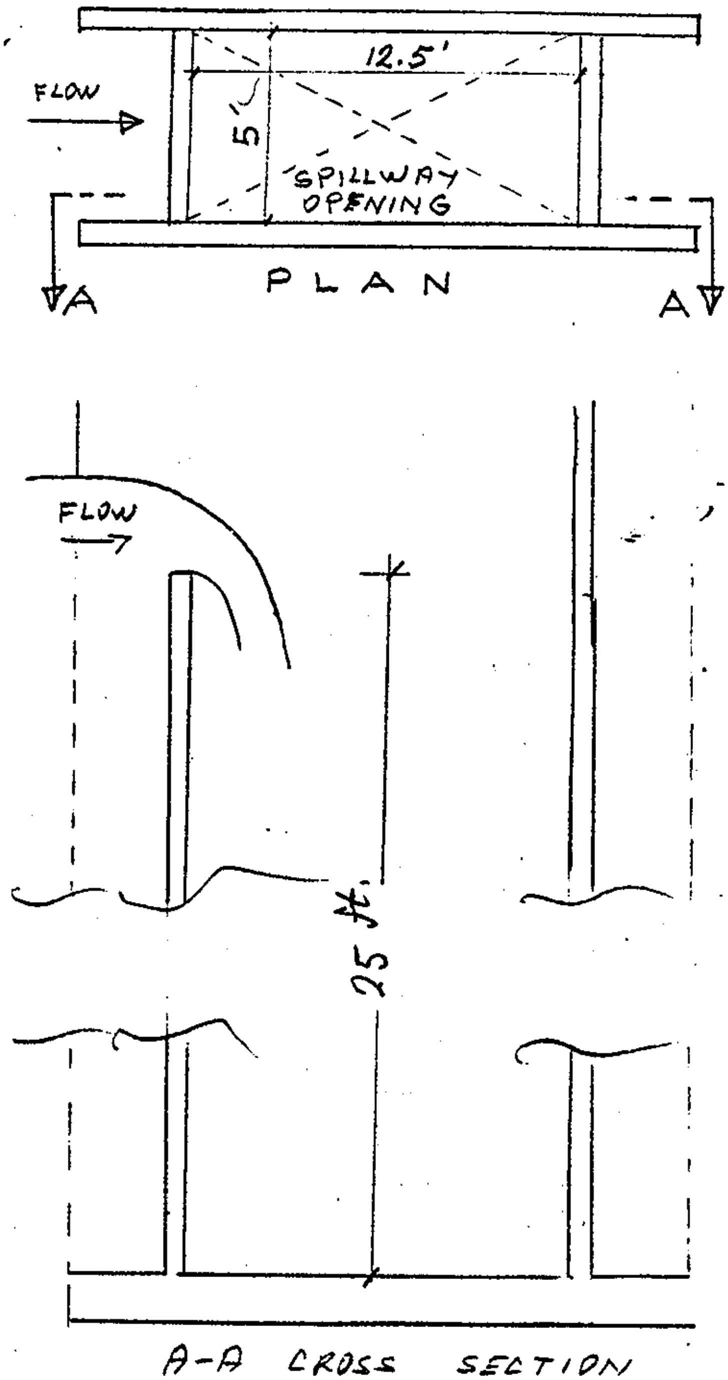
H = (Q/(C*L))^(2/3)

Where ,

Q is the discharge (cfs)
L is the lenght (ft)
C is the spillway coefficient
H is the surcharge height (ft)

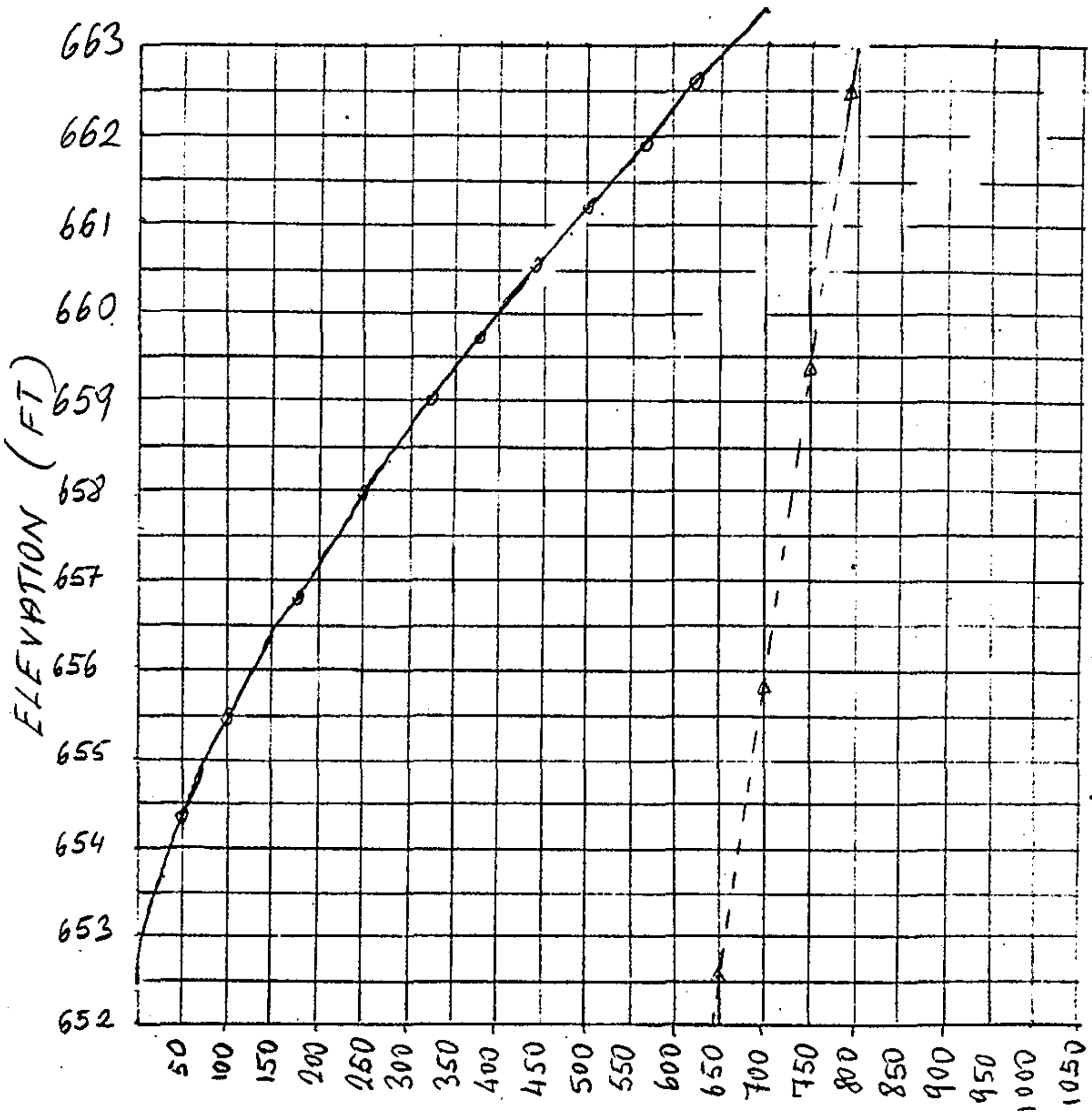
SPILLWAY CREST EL.= 652.5 (ft)
SPILLWAY COEFF.= 3.9
TOTAL SPILLWAY LENGHT= 5 (ft)

ELEVATION (ft)	DISCHARGE (cfs)
652.9	5
653.14	10
653.68	25
654.37	50
654.95	75
655.47	100
655.95	125
656.39	150
656.81	175
657.22	200
657.6	225
657.97	250
658.33	275
658.68	300
659.02	325
659.35	350
659.67	375
659.99	400
660.3	425
660.6	450
660.9	475
661.19	500
662.31	600
663.38	700
664.39	800
665.36	900
666.3	1000



MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072-018 — Sheet 6 of 25
Subject: FLOOD ROUTING — By T. OTOVA — Date 5-5-81
CHRISTINA RESERVOIR — Ckd. — Rev.



⊙ PRINCIPAL SPILLWAY INLET RATING CURVE.

Δ PRINCIPAL SPILLWAY OUTLET (PIPE) RATING CURVE

——— PRINCIPAL SPILLWAY RATING CURVE.

- - - - - EXTENSION OF THE RATING CURVES.

For 5.06 sq. mi. drainage area and for rolling terrain

$q = 1700 \times \frac{13''}{19''} = 1163$ cfs./sq.mi.

$Q_{PMF} = 1163 \times 5.06 = 5885$ CFS

Results:

Inflow = 5885 CFS
Outflow = 0.0 CFS.

Max. Reservoir Elev = 657.6 FT.

For 657.6 water surface elevation the length of the waterline at the surface of the dam is about 0.5 miles = 2640 FT.

Max. depth of water = 657.6 − 632 = 25.6 FEET.

The volume in the reservoir = 7308 AC-FT.

Although there will be no overtopping through the dam, the dam breach calculations are performed to estimate potential hazards due to a dam breach caused by other reasons. The calculations are presented in the following pages.

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 8 of 25
Subject FLOOD ROUTING THROUGH RESERVOIR By T. OTOVA Date 4-15-80
CHRISTINA RESERVOIR Ckd. Rev.

Drainage Area = 5.06 square miles
Normal Pool Elv. 652.5 FT.
Reservoir Capacity 3800 AC-FT.

The top of the dam Elev. 662.5 FT
Reservoir Capacity 9133 AC-FT.

Δ Volume : 9133 - 2500 = 6633 AC-FT. . . . (A)

Total Runoff is 13"

$$\text{Total Runoff} = 13\ IN \times \frac{FT}{12\ IN} \times 5.06\ MI^2 \times \frac{5280^2\ FT^2}{MI^2} \times \frac{AC\text{-}FT}{43560\ FT^3}$$

" " = 3508 AC-FT. . . . . (B)

(B) < (A)

The result shows that total runoff during probable maximum precipitation event can be stored in the reservoir between elevations 650 - 660 FT.

The total volume in the reservoir will be

3508 + 3800 = 7308 AC-FT.

This corresponds to the water surface elev. of 657.6 FT.

The peak inflow during PMF is estimated by the procedures of Corps of Eng. Guidelines.

MAIN

Client CORPS OF ENGINEERS — Job No. 1345-072-018 — Sheet 9 of 25
Subject FLOOD ROUTING THROUGH CHRISTINA RESERVOIR — By T. OTOUA — Date 3-4-81
Ckd. — Rev.

For ELV. 657.6 ft. discharge from principal spillway:

$$Q = 3.3 \times 10 \times (657.6 - 652.5)^{3/2}$$

$$Q = 380 \text{ cfs.}$$

If we add about 80 cfs from the 24" drain pipe the total discharge becomes

$$Q = 460 \text{ cfs}$$

Results:

Inflow = 5885 cfs
Outflow = 460 cfs
Max. Reservoir Elev. = 657.6 ft
The corresponding Volume = 7308 ac-ft.
Top of the dam = 662.5 ft.
No overtopping occurs.
Max. Water depth = 25.6 ft.

MAIN

Client CORPS OF ENGINEERS Job No. 1345-073-018 Sheet 9 B of
Subject FLOOD ROUTING THROUGH CHRISTINA RESERVOIR By T. OTOVA Date 5-5-81
Ckd. Rev.

If we assume spillway with stoplogs and initial pool level at 657.5 ft,

The storage at Elv. 657.5 = 7300 AC-FT.

The " " top of the dam = 13 900* AC-FT

$$^{*}Exp\left[(662.50 - 589.131)/7.691\right] = 13899$$

(see page 2).

The available storage = 13 900 − 7300 = 6 600 AC-FT.

Total runoff = 3508 AC-FT (see page 8)

Total runoff < storage available

Total storage = 3508 + 7300 = 10808 AC-FT.

Corresponding Elv = 660.60 FT.

The dam is composed with two embankments joining each other with wide angle. Any breach of these embankments will cause the flows to flow in different hydrologic catchments. For this reason the calculations are performed by considering a breach of the embankment which will endanger a populated area. The total length of this embankment is 2640 ft.

CHRISTINA RESERV.
DAM FAILURE ANALYSES

These calculations are performed according to the RULE OF THUMB procedures of the Corps of Engineers

The breach discharge:
Qp1 = 8/27 * Wb * g^0.5 * Yo^3/2

Where,

Yo is the height of the breach (from river bed to the max. pool level)

Wb is 35% of the length of the dam, or Wb = .35 * Wd

g is the acceleration of the gravity (32.2 ft/sec^2)

Yo = 25.6 (ft)

Wd = 2640 (ft)

Wb = 924 (ft)

From above equation,
Qp1 = 201226 (cfs)

The natural channel cross sections are simplyfied as triangular cross sections

The stage-discharge relationship becomes as,

h = [1.068 * n * Tan(a) * Q * Cos(a)^2/3 / S^.5]^3/8 ....(I)

Where,

Q = Discharge (cfs)
a = Side slope angle (deg)
S = Channel slope

The cross section Area:

A = h^2 / Tan(a) ....(II)

The Volume of the Reservoir.
V = 7308 (ac-ft)
or,
V = 318336480 (cub-ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 11 of 25
Subject DAM FAILURE ANALYSES By T. OTOIA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

R E A C H (1) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.09 (deg.)
S = .001
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3.1 (ft)

From Formula (II) ,

A1 = 509 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 30.4 (ft)

From Formula (II),
Total Area,
A = 48860 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 48350 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 65273647 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 159966 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 160426 (cfs)

h = 27 (ft)

From Formula (II),

A = 41153 (ft)

Residual Area,

A2 = A - A1

A2 = 40643 (ft)

V2 = A2 * L

V2 = 54869027 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 60071337 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 163254 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 28.1 (ft)

RESULTS :

1.) Prefailure Height = 3.1 (ft)

2.) Postfailure Height = 28.1 (ft)

3.) Breach Discharge = 163254 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 12 of 25
Subject DAM FAILURE ANALYSES By T. OTOLA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

R E A C H (2) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.02 (deg.)
S = .001
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 518 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 27.5 (ft)

From Formula (II),
Total Area,
A = 42483 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 41965 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 56652898 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 134200 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 134660 (cfs)

h = 25 (ft)

From Formula (II),

A = 36693 (ft)

Residual Area,

A2 = A - A1

A2 = 36174 (ft)

V2 = A2 * L

V2 = 48836015 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 52744457 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 136205 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 25.7 (ft)

RESULTS

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 25.7 (ft)

3.) Breach Discharge = 136205 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS — Job No. 1345-072-018 — Sheet 13 of 25
Subject DAM FAILURE ANALYSES — By T. OTOOLE — Date 3-4-81
CHRISTINA DAM — Chkd. — Rev.

REACH (3) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 95 (deg.)
S = .001
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 2.9 (ft)

From Formula (II) ,

A1 = 527 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 25 (ft)

From Formula (II),
Total Area,
A = 37767 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 37239 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 50273307 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 114695 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 115155 (cfs)

h = 23 (ft)

From Formula (II),

A = 33214 (ft)

Residual Area,

A2 = A - A1

A2 = 32687 (ft)

V2 = A2 * L

V2 = 44127739 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 47200523 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 116009 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 23.5 (ft)

RESULTS :

1.) Prefailure Height = 2.9 (ft)

2.) Postfailure Height = 23.5 (ft)

3.) Breach Discharge = 11600 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (4) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = .61 (deg.)
S = .001
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 2.5 (ft)

From Formula (II) ,

A1 = 589 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 19.9 (ft)

From Formula (II),
Total Area,
A = 37421 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 36831 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 49722802 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 97889 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 98349 (cfs)

h = 18 (ft)

From Formula (II),

A = 32963 (ft)

Residual Area,

A2 = A - A1

A2 = 32374 (ft)

V2 = A2 * L

V2 = 43705278 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 46714040 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 98986 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 18.8 (ft)

RESULTS :

1.) Prefailure Height = 2.5 (ft)

2.) Postfailure Height = 18.8 (ft)

3.) Breach Discharge = 98986 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (5) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = .46 (deg.)
S = 001
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 2.2 (ft)

From Formula (II) ,

A1 = 632 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 16.9 (ft)

From Formula (II),
Total Area,
A = 35668 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 35036 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 47298798 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 34278 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 84738 (cfs)

h = 15 (ft)

From Formula (II),

A = 31634 (ft)

Residual Area,

A2 = A - A1

A2 = 31001 (ft)

V2 = A2 * L

V2 = 41852276 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 44575537 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 85125 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 15.9 (ft)

RESULTS :

1.) Prefailure Height = 2.2 (ft)

2.) Postfailure Height = 15.9 (ft)

3.) Breach Discharge = 85125 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (6) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = .59 (deg.)
S = .003
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 2 (ft)

From Formula (II) ,

A1 = 393 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 14.2 (ft)

From Formula (II),
Total Area,
A = 19836 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 19442 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 26247182 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 73106 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 73566 (cfs)

h = 13 (ft)

From Formula (II),

A = 18603 (ft)

Residual Area,

A2 = A - A1

A2 = 18209 (ft)

V2 = A2 * L

V2 = 24582641 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 25414911 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 78329 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 13.8 (ft)

RESULTS :

1) Prefailure Height = 2 (ft)

2.) Postfailure Height = 13.8 (ft)

3) Breach Discharge = 78329 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (7) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 271 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 20.6 (ft)

From Formula (II),
Total Area,
A = 12866 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 12594 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 17002436 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 74145 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 74605 (cfs)

h = 20 (ft)

From Formula (II),

A = 12350 (ft)

Residual Area,

A2 = A - A1

A2 = 12078 (ft)

V2 = A2 * L

V2 = 16306029 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 16654232 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 74231 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 20.2 (ft)

RESULTS :

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 20.2 (ft)

3.) Breach Discharge = 74231 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client: CORPS OF ENGINEERS — Job No. 1345-072-018 — Sheet 18 of 25

Subject: DAM FAILURE ANALYSES — By: T. OTOVA — Date: 3-4-81

CHRISTINA DAM — Ckd. — Rev.

R E A C H (8) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 271 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 20.2 (ft)

From Formula (II),
Total Area,
A = 12360 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 12089 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 16320387 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 70425 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 70885 (cfs)

h = 19 (ft)

From Formula (II),

A = 11885 (ft)

Residual Area,

A2 = A - A1

A2 = 11613 (ft)

V2 = A2 * L

V2 = 15678551 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 15999469 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 70500 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 19.8 (ft)

RESULTS :

1.) Prefailure Height = (ft)

2.) Postfailure Height 19.8 (ft)

3.) Breach Discharge = 70500 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 19 of 25
Subject DAM FAILURE ANALYSES By T. OTOIA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

R E A C H (9) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 271 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 19.8 (ft)

From Formula (II),
Total Area,
A = 11894 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 11623 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 15691253 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 67025 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 67485 (cfs)

h = 19 (ft)

From Formula (II),

A = 11455 (ft)

Residual Area,

A2 = A - A1

A2 = 11183 (ft)

V2 = A2 * L

V2 = 15097770 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 15394512 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 67091 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 19.5 (ft)

RESULTS :

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 19.5 (ft)

3.) Breach Discharge = 67091 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (10) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 271 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 19.5 (ft)

From Formula (II),
Total Area,
A = 11463 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 11191 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 15109063 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 63906 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 64366 (cfs)

h = 19 (ft)

From Formula (II),

A = 11055 (ft)

Residual Area,

A2 = A - A1

A2 = 10784 (ft)

V2 = A2 * L

V2 = 14558630 (cub-ft)

Vavg = (V1 + V2) / 2

Vavg = 14833847 (cub-ft)

Qp2 = Qp1 * (1 - Vavg / V)

Qp2 = 63964 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 19.1 (ft)

RESULTS

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 19.1 (ft)

3.) Breach Discharge = 63964 (cfs)

4.) Reach Length = 1350 (ft)

R E A C H (11) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II) ,

A1 = 271 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 19.1 (ft)

From Formula (II),
Total Area,
A = 11063 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 10791 (sq-ft)

Residual volume,

V1 = L * A2

V1 = 14568717 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 61037 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 61497 (cfs)

h = 18 (ft)

From Formula (II),

A = 10684 (ft)

Residual Area,

A2 = A - A1

A2 = 10412 (ft)

V2 = A2 * L

V2* = 14056783 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 14312750 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 61088 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 18.8 (ft)

RESULTS :

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 18.8 (ft)

3.) Breach Discharge = 61088 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 22 of 25
Subject DAM FAILURE ANALYSES By T. OTOLA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

REACH (1) CALCULATIONS

Test flood discharge
Qt = 460 (cfs)

a = 1.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3 (ft)

From Formula (II),

A1 = 271 (sq.ft)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 13.8 (ft)

From Formula (II),
Total Area,
A = 10690 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 10419 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 14065830 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 58389 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 58849 (cfs)

h = 13 (ft)

From Formula (II),

A = 10337 (ft)

Residual Area,

A2 = A - A1

A2 = 10065 (ft)

V2 = A2 * L

V2 = 13588467 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 13827148 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 58435 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 13.5 (ft)

RESULTS :

1.) Prefailure Height = 3 (ft)

2.) Postfailure Height = 13.5 (ft)

3.) Breach Discharge = 58435 (cfs)

4.) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 23 of 25
Subject DAM FAILURE ANALYSES By T. OTOTA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

R E A C H (17) CALCULATIONS

Test flood discharge
Qt = 460 (cfs)

a = 2.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3.5 (ft)

From Formula (II),

A1 = 244 (sq-ft)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 21.7 (ft)

From Formula (II),
Total Area,
A = 9307 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 9063 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 12235607 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 56189 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 56649 (cfs)

h = 21 (ft)

From Formula (II),

A = 9040 (ft)

Residual Area,

A2 = A - A1

A2 = 8795 (ft)

V2 = A2 * L

V2 = 11874461 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 12055034 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 56222 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 21.4 (ft)

RESULTS :

1.) Prefailure Height = 3.5 (ft)

2.) Postfailure Height = 21.4 (ft)

3.) Breach Discharge = 56222 (cfs)

4.) Reach Length = 1350 (ft)

REACH (14) CALCULATIONS

Test flood discharge
Qt = 460 (cfs)

s = 0.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3.5 (ft)

From Formula (II) ,

A1 = 244 (sq-ft)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 21.4 (ft)

From Formula (II),
Total Area,
A = 9044 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 8799 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 11879817 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 54124 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 54584 (cfs)

h = 21 (ft)

From Formula (II),

A = 8792 (ft)

Residual Area

A2 = A - A1

A2 = 8547 (ft)

V2 = A2 * L

V2 = 11539255 (cub-ft)

Vave = (V1 - V2) / 2

Vave = 11709536 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 54154 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 21.1 (ft)

RESULTS :

1) Prefailure Height = 3.5 (ft)

2) Postfailure Height = 21.1 (ft)

3) Breach Discharge = 54154 (cfs)

4) Reach Length = 1350 (ft)

MAIN

Client CORPS OF ENGINEERS Job No. 1345-072-018 Sheet 25 of 25
Subject DAM FAILURE ANALYSES By T. OTOIVA Date 3-4-81
CHRISTINA DAM Ckd. Rev.

R E A C H (15) CALCULATIONS

Test flood discharge:
Qt = 460 (cfs)

a = 2.9 (deg.)
S = .0037
n = .07
L = 1350 (ft)

From Formula (I),

Prefailure height,

h1 = 3.5 (ft)

From Formula (II) ,

A1 = 244 (sq.ft.)

Q = Qp1 + Qt

From Formula (I),
Total Height,
h = 21.1 (ft)

From Formula (II),
Total Area,
A = 8795 (sq-ft)

Residual Area,
A2 = A - A1
A2 = 8551 (sq-ft)

Residual Volume,

V1 = L * A2

V1 = 11544159 (cub-ft)

Qp2 = Qp1 * (1 - V1 / V)

Qp2 = 52190 (cfs)

From Formula (I),

Q=Qp2+Qt

Q = 52650 (cfs)

h = 20 (ft)

From Formula (II),

A = 8557 (ft)

Residual Area,

A2 = A - A1

A2 = 8312 (ft)

V2 = A2 * L

V2 = 11222461 (cub-ft)

Vave = (V1 + V2) / 2

Vave = 11383310 (cub-ft)

Qp2 = Qp1 * (1 - Vave / V)

Qp2 = 52218 (cfs)

From Formula (I),

Q = Qp2 + Qt

h2 = 20.8 (ft)

RESULTS :

1.) Prefailure Height = 3.5 (ft)

2.) Postfailure Height = 20.8 (ft)

3.) Breach Discharge = 52218 (cfs)

4.) Reach Length = 1350 (ft)

APPENDIX E

Information as Contained in the "National Inventory of Dams in the United States"

PART I – INVENTORY OF DAMS IN THE UNITED STATES

(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

FORM APPROVED
OMB NO. 49-R0421

REQUIREMENTS CONTROL SYMBOL
DAEN-CWE-17

[1] STATE / IDENTITY NUMBER: ME00226

IDENTIFICATION

[2] DIVISION	[3] STATE	[4] COUNTY	[5] CONGR DIST	[6] STATE	[7] COUNTY	[8] CONGR DIST	[9] NAME	[10] LATITUDE (North)	[11] LONGITUDE (West)	[12] REPORT DATE (DAY MO YR)	80
NED	ME	003	02				LAKE CHRISTINA	4641.4	6753.5	10MAR81	0

IDENTIFICATION (Continued)

[13] POPULAR NAME	[14] NAME OF IMPOUNDMENT	80
SAME	LAKE CHRISTINA	1

LOCATION

[15] REGION	[16] BASIN	[17] RIVER OR STREAM	[18] NEAREST DOWNSTREAM CITY – TOWN – VILLAGE	[19] DIST. FROM DAM (mi)	[20] POPULATION	80
01	01	PRESTILE STREAM	EASTON	3	2000	2

STATISTICS

[21] TYPE OF DAM	[22] YEAR COMPLETED	[23] PURPOSES	[24] STRUCTURAL HEIGHT (ft)	[25] HYDRAULIC HEIGHT (ft)	[26] IMPOUNDING CAPACITIES MAXIMUM (acre – ft.)	[27] NORMAL (acre – ft.)	[27A] CORPS ENGR. DIST.	[27B] OWN.	[27C] FED. R.	[27D] PRV/FED	[27E] SCS A.	[27F] VERIFICATION DATE (DA MO YR)	BLANK	80
RE	1967	S	30	25	13960	3800		N	N	N	N	15AUG79		3

REMARKS

[28] REMARKS	80
	4

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PART II – INVENTORY OF DAMS IN THE UNITED STATES
(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

FORM APPROVED
OMB NO. 49-R0421
REQUIREMENTS CONTROL SYMBOL
DAEN-CWE-17

[1] STATE		IDENTITY NUMBER				
1	2	3	4	5	6	7
M	E	0	0	2	2	6

STATISTICS

[29] D/S HAZ	[30] CREST LENGTH (ft)	[31] SPILLWAY TYPE	[32] SPILLWAY WIDTH (ft)	[33] SPILLWAY MAXIMUM DISCHARGE (cfs)	[34] VOLUME OF DAM (CY)	[35] POWER CAPACITY INSTALLED (MW)	[36] POWER CAPACITY PROPOSED (MW)	[37] NAV. LOCKS NO.	[38] LENGTH (ft)	[39] WIDTH (ft)	[40] LENGTH (ft)	[41] WIDTH (ft)	[42] LENGTH (ft)	[43] WIDTH (ft)	[44] LENGTH (ft)	[45] WIDTH (ft)	BLANK	
8	9–13	14	15–18	19–25	26–34	35–40	41–46	47	48–51	52–54	55–58	59–61	62–65	66–68	69–72	73–75	76–79	80
1	5800	U	5	380														5

MISC. DATA

[46] OWNER	[47] ENGINEERING BY	[48] CONSTRUCTION BY	
8–31	32–55	56–79	80
MC CAIN FOODS	WILLIAM WHITED	BRIDGE CONST CO	6

MISC. DATA (Continued)

REGULATORY AGENCY [49] DESIGN	[50] CONSTRUCTION	[51] OPERATION	[52] MAINTENANCE	
8–25	26–43	44–61	62–79	80
NONE	NONE	NONE	NONE	7

MISC. DATA (Continued)

[53] INSPECTION BY	[54] INSPECTION DATE DAY	MO	YR	[55] AUTHORITY FOR INSPECTION	
8–40	41–42	43–44	45–47	48–79	80
NONE					8

REMARKS

[56] REMARKS	
8–79	80
	9

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①

PART III - INVENTORY OF DAMS IN THE UNITED STATES
SUPPLEMENTARY DATA

STATE (1–2)	IDENTITY NUMBER (3–7)
ME	00226

LOCATION

	(A-1) TOWN (8–27)	(A-2) NED PERMIT NO. (28–34)	(A-3) STATE NUMBER (35–46)	(A-4) F.E.R.C. NO. (47–52)	(A-5) U.S.G.S. SHEET (53–73)	(74–79)	80
LOCATION	EASTON				MARS HILL, ME		A

DRAINAGE CHARACTERISTICS

	(B-1) DRAINAGE AREA SQ MI (8–12)	(B-2) FLOW DATA MIN. C.F.S. (13–18)	(B-3) FLOW DATA AVE. C.F.S. (19–24)	(B-4) FLOW DATA MAX. C.F.S. (25–30)	(B-5) CREST ELEV. M.S.L. (31–34)	(B-6) ABUT. ELEV. M.S.L. (35–38)	(B-7) USABLE STORAGE ACRE FEET (39–47)	(B-8) RESERVOIR AREA ACRES (48–54)	(B-9) FLASH BOARD HT. FEET (55–59)	(B-10) OUTLET CONDUITS NO. (60–61)	(B-11) OUTLET CONDUITS SIZE (62–70)	(B-12) INVERT ELEV. M.S.L. (71–74)	(75–79)	80
DRAINAGE CHARACTERISTICS	5.1				662		3800	480		2	24¢60 1W	638		B

POWER DATA

	(C-1) GENERATION UNITS INSTALLED NO. / CAP / K.W. (8–15)	(C-2) GENERATION UNITS PLANNED NO / CAP. / K.W. (16–23)	(C-3) AVERAGE ANNUAL GENERATION K.W.H. (24–33)	(C-4) LAST GEN YEAR (34–37)	(C-5) RETIRED YEAR (38–41)	(C-6) FORMER USE (42–49)	(C-7) CAPACITY FACTOR (50–53)	(54–79)	80
POWER DATA	0								C

	(8–79)	80
		D

	(8–79)	80
		E

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Lake Christina Dam, Fort Fairfield, Maine: phase I inspection report, National Dam Inspection Program. -- Waltham, Mass. : U.S. Army Corps of Engineers, New England Division, 1981.

vi, [60] p. : ill., maps ; 28 cm. -- (ME00226)

"September 1981"

1. Dams--Inspection--Maine--Lake Christina Dam. 2. Dam safety--Maine--Lake Christina Dam. 3. Lake Christina Dam (Me.)--Inspection. 4. Fort Fairfield (Me.)--Dams. 5. Saint John River watershed (Me.)--Dams. I. United States. Army. Corps of Engineers. New England Divis ion. II. Series

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